

A MCGRAW-HILL PUBLICATION

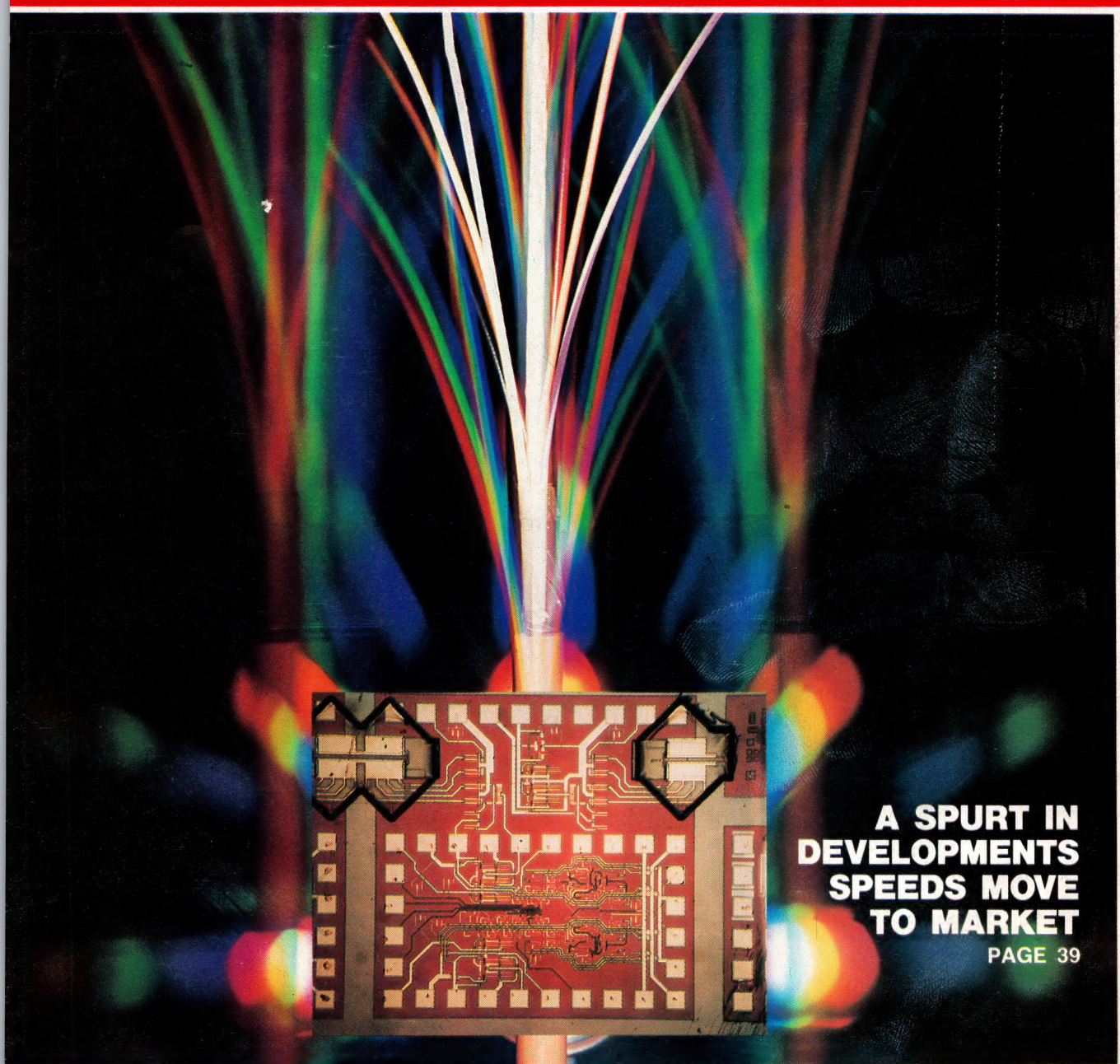
THREE DOLLARS

Electronics

THE WORLDWIDE TECHNOLOGY WEEKLY

NOVEMBER 18, 1985

OPTICAL ICs THE NEW ALTERNATIVE



**A SPURT IN
DEVELOPMENTS
SPEEDS MOVE
TO MARKET**

PAGE 39

**LEXIBLE INSPECTION: THE HOT TOPIC AT CHERRY HILL/57
WILL JAPANESE IC MAKERS COME ROARING BACK AGAIN?/82**

Open one up.

And feel your pulse accelerate. 50,000 logic gates on a single chip. Room enough to implement large macro-functions and build an entire digital system.

All with our new LCA 10000 Compacted Array™ Series.

In theory, somewhere between a gate array and a cell-based custom IC.

In practice, it's a flat-out acceleration of our ASIC technology. With advanced 1.5 micron, dual-layer HCMOS technology. And our innovative variable routing tracks.

For performance no mere gate array can touch. 0.7 nanosecond propagation delay for a 2-input NAND gate. ECL-like speeds. Random Routing. VHSIC performance compatibility. And more.

You'll get there fast, too, using our proprietary LDS™ Design System. Working at any of our 12 worldwide design centers.

And you'll get there safely. Thanks to our proven 97% first-time hit rate.

With manufacturing in our facilities. The best equipped in the country. Geared to pump out all you need. From hundreds. To hundreds of thousands. All thoroughly tested on our 256-pin system.

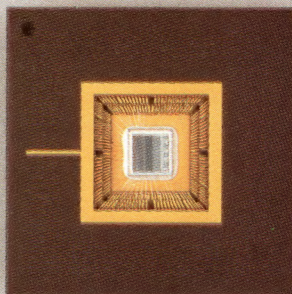
Start yours today. Call one of our sales offices listed below.

Because with our new Compacted Array Series driving your next design

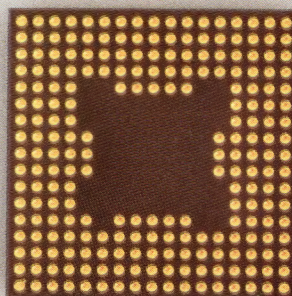
there's no telling how far you'll go.

Or how fast.

**LSI LOGIC
CORPORATION**



Our new 50,000-gate LCA 10000 Compacted Array Series makes "System Scale Integration" a reality. Now, you can fit an entire system on a chip.



Even the packaging is advanced, with up to 256 I/O signal pins.

**0-50,000
IN 0.7 NSEC.**

**INTRODUCING
OUR 1986
COMPACTS.**

The only thing small about it is its size!

The RTP-650A is the only portable data recorder that gives you bigger performance than a reel-to-reel.

- **DC to 40kHz frequency response on 14 (or 21) channels** — at a 76.2cm/sec (30 ips) on Beta format video cassette tape. Covers twice the IRIG WBG1 bandwidth on any of the other six tape speeds. WBG1 is selectable for an even better SN ratio.
- **Superior vibration resistance (tested in conformity with MIL-STD-810C)** plus a compact and lightweight design give you a wholly new latitude of applications.
- **FM, DR and PCM recording — three modes in all** A first for a desktop data recorder.
- **Optionally available GP-IB port** lets you easily configure a computer-controlled data acquisition and processing system.

And it's easier to use than any other data recorder....

- **Bright easy-to-read menu style EL display** provides the window for easy access to the multi-microprocessor intelligence.
- **Programmable settings for simpler operation** Even an unskilled operator can use it on site.

Learn more about the RTP-650A and its many other exciting features. Write or call:

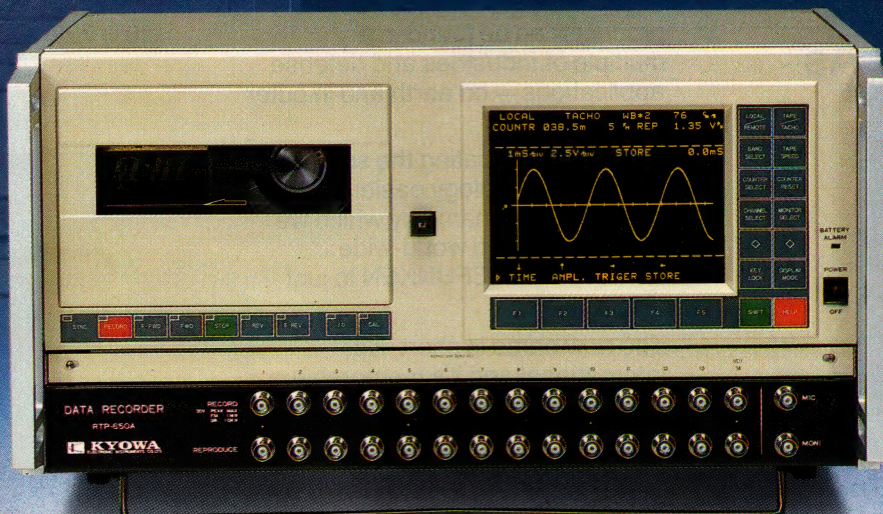
KYOWA
KYOWA ELECTRONIC INSTRUMENTS CO., LTD.

3-8, Toranomon 2-chome, Minato-ku, Tokyo

Phone: 03-502-3551

Cable: KYOWASTRAINGAGE TOKYO

Telex: 222-3854 KYOWAT J



RTP-650A
VIDEO CASSETTE DATA RECORDER

Circle 1 on reader service card



Finding High Technology In America Is As Easy As AEG

Advanced technology from AEG impacts electrical and electronic equipment, communication and information systems, automation and power applications. Our products can be found in a multiple of industries and defense applications — on earth and in outer space.

We've made locating the source for this high technology easier by shortening the name by which we were recognized world-wide: from AEG-TELEFUNKEN to just simply AEG.

The new name is short, it's international and it's memorable. Our 100 year old tradition of quality and commitment to technological advancement has not changed. High Technology ... As Easy As AEG

To find out more about the full line of AEG products contact:
AEG Corporation,
Route 22 - Orr Drive, PO Box 3800,
Somerville, NJ 08876-1269,
(201) 722-9800

AEG

"SEE US AT WESCON BOOTH NO. 804"

Electronics

NEWS

Newsletters

Technology, 17

- A 61.4-gigaflips supercomputer is in the works
 - CMOS and bipolar join forces in TI 32-bit chip set
- #### Electronics, 19
- Motorola quits n-MOS 256-K dynamic RAM business
 - Founder leaves Apollo Computer to start another work-station maker

Microprocessors, 23

Parallel-processing engines move inside IBM PC for number-crunching tasks

Computers, 24

- Can Data General catch up again with new work stations and supermini?
- A single-chip path to denser multiprocessing

Semiconductors, 25

Vertical FET gives NTT twice the chip density

Graphics, 25

Intel, Matra-Harris team develops graphics chip

CAD, 26

Work station spews out VLSI designs faster

Trade, 26

ITC agrees: Japan has hurt U. S. chip makers

Logic devices, 27

New architecture is built in programmable logic

Medical, 30

Digitizing X rays to enhance, store easier

Company strategies, 30

Convergent's tricky new game plan

Consumer, 31

A new try to raise TV and VCR prices

IC production, 34

Siliconix joins Class 1 clean-room elite

INSIDE TECHNOLOGY

Handling digital satellite signals economically, 50

A low-cost high-speed digital signal processor capable of digitizing 20-MHz video signals with 8-bit accuracy eliminates the effects of atmospheric distortion and permits security coding in TV satellite broadcasting

Flexible inspection is hot topic at Cherry Hill, 57

Test systems that can switch instantly among testing tasks using machine vision, thermographs, and laser probes will draw designers' interest at the International Test Conference

PROBING THE NEWS

Will Japanese IC makers roar back again? 82

They will if history repeats itself: their plans to move quickly after new markets are strongly reminiscent of the market rebound in 1981, when they grabbed the lion's share of the 64-K dynamic RAM business and laid the groundwork for near-total ownership of the 256-K DRAM market

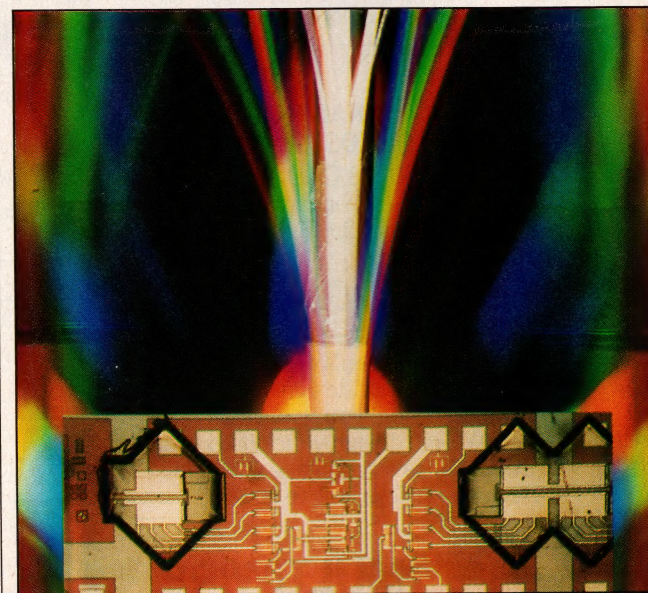
For excitement, try 5¼-in. disk-drive market, 85

A dogfight is brewing as drive makers try to establish a clear dominance in products of 175 megabytes and up. Production problems and low-ball pricing could be stumbling blocks

AT&T's second thoughts on commodity chips, 87

Despite its size, it appears that the company is neither capable of, nor interested in, dominating the commodity-chip market. But it hopes to establish a strong reputation there and move on to capture some smaller niches

COVER



Special Report: Optical ICs—a new alternative, 39

Fueled by a spurt in fabrication advances, integrated optical circuits are staking a claim in high-performance applications where silicon technology has long ruled

Cover: fiber-optic photo by Manfred Kage, Peter Arnold Inc.

NEW PRODUCTS

Newsletter, 21

- High-capacity 5¼-in. drives embed their controllers
- Fast ion-deposition printers go to market

Wescon roundup, 98

- Tektronix' touch-sensitive panel works with CRT, EL, and plasma displays
- Waveform processing enhances LeCroy's scope
- National Instrument's card turns the IBM PC into a bus analyzer
- Backplane tester from Dawn simplifies VMEbus systems design
- Ballantine's ac calibrator is fully automatic
- Fairchild expands its power MOS FET line
- Low-priced scope from Beckman Industries has sweep-delay feature
- Motorola puts EEPROM on 8-bit processor
- PROM burner from Data I/O is four times faster
- Gould's six logic analyzers cover the spectrum

Test systems, 105

LTX uses asynchronous patterns on system to test ICs with two clock rates

DEPARTMENTS

Publisher's letter, 5

Meetings, 12

Companies, 92

Is AMD's Texas strategy getting it into trouble?

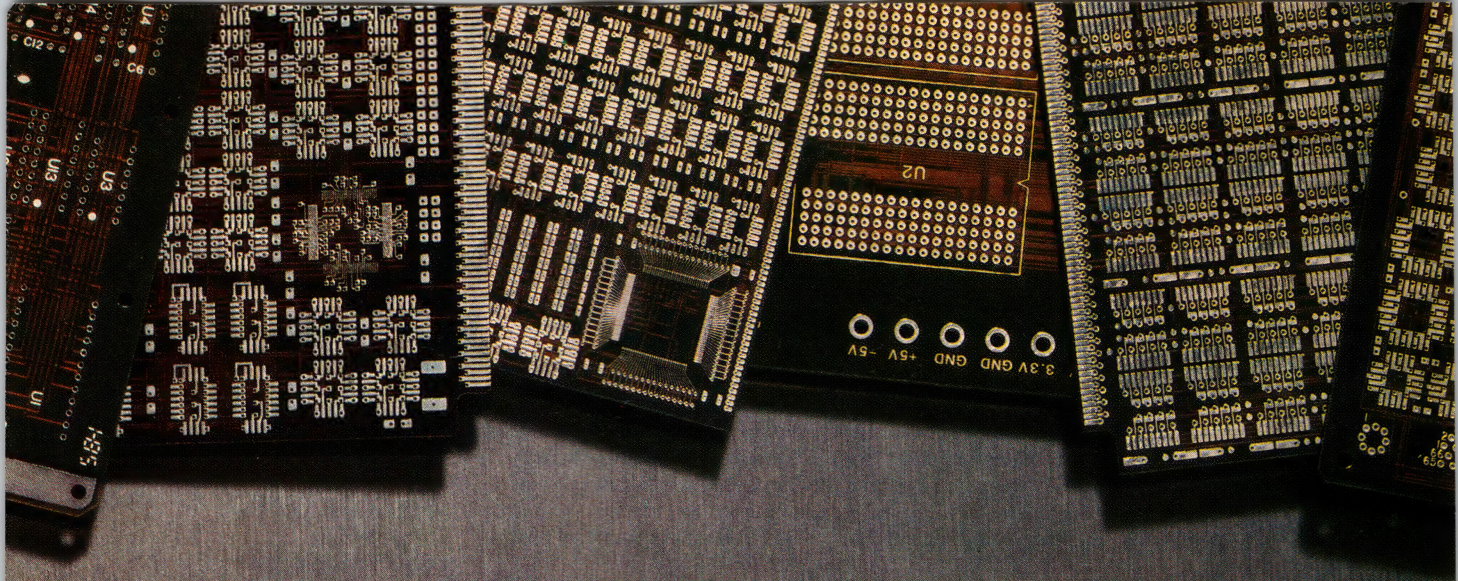
Bottom lines, 93

Electronics index, 95

People, 96

- "No more software best-sellers," says Lotus's Belove
- Philips ECG chief is an engineer... and a woman
- People on the move

Electronics week, 108



WHY MULTIWIRE® CIRCUIT BOARDS ARE THE BEST CHOICE FOR YOUR NEXT APPLICATION.

Because Multiwire circuit boards use round, insulated wire for signal interconnections, instead of etched foil, their physical and electrical properties make them the best response to the technical challenges of your next application.

SURFACE-MOUNTED DEVICES.

Multiwire Division's experience designing boards for new package types encompasses both leaded and leadless devices, including LCC's with pin pitches of 18 mils or more and pin grid arrays.

VHSIC/VLSI APPLICATIONS.

Multiwire circuit boards readily handle high I/O count devices. We have successfully designed boards to accommodate pin grid array components with 130 pins and greater.

HIGH-SPEED APPLICATIONS.

High-speed circuits demand critical timing and flexibility to control wire lengths. The Multiwire circuit board construction, wire characteristics, and

routing system lend themselves to implementing controlled impedance designs in even the most complex, high-speed designs.

THERMAL MANAGEMENT.

A variety of approaches have been used with Multiwire circuit boards to achieve successful thermal management—from the addition of heat sinks or copper planes to the use of special substrates.

GREATER PACKAGING DENSITIES AT REDUCED COSTS.

Our sophisticated CAD tools routinely design boards accommodating component densities of 2.0 IC's per square inch or greater.

FASTER DESIGN. LESS EXPENSIVE REVISIONS.

Multiwire Division's design services can shorten your design cycle by weeks and save you thousands of dollars. We can design your board from as little input as a schematic and net list. Design revisions will be fast and

inexpensive. And your prototype boards will be 100% electrically tested.

We'd like to send you our brochure, which explains the technology in more detail and why Multiwire Division is your best source. To receive your copy, simply fill out and return the coupon.

MULTIWIRE DIVISION Kollmorgen Corporation

10 Andrews Rd., Hicksville, NY 11801

- ☐ Please send me your sales brochure.
- ☐ Please have a salesperson call.

Name _____

Title _____

Company _____

Address _____

City _____ State _____ Zip _____

Telephone _____

E-11



KOLLMORGEN CORPORATION

MULTIWIRE/EAST 250 Miller Place, Hicksville, NY 11801 (516) 933-8300; MULTIWIRE/NEW ENGLAND 41 Simon St., Nashua, NH 03060 (603) 889-0083
MULTIWIRE/WEST 3901 East La Palma Ave., Anaheim, CA 92807 (714) 632-7770; MULTIWIRE DIVISION 10 Andrews Rd., Hicksville, NY 11801 (516) 938-2000
Multiwire is a U.S. registered trademark of the Kollmorgen Corporation.

Circle 4 on reader service card

"SEE US AT WESCON BOOTH # 202"

Electronics

International edition

EDITOR-IN-CHIEF

Robert W. Henkel

EXECUTIVE EDITORS

Samuel Weber (technical), Arthur Erikson (news)

ASSOCIATE MANAGING EDITORS

Howard Wolff, Benjamin A. Mason

ASSISTANT MANAGING EDITORS

Tom Manuel, Jeremy Young

SENIOR EDITOR

Kevin Smith

ART DIRECTOR

Fred Sklenar

DEPARTMENT EDITORS

Business: Robert J. Kozma

Communications: Robert Rosenberg

Computers & Peripherals: Tom Manuel

Government & Military: George Leopold

Industrial & Consumer: David M. Weber

New Products: Steve Zollo, Ann Jacobs

Packaging & Production: Jerry Lyman

Semiconductors: Bernard C. Cole (Palo Alto)

Software & Microsystems: Alexander Wolfe

Test & Measurement: Samuel Weber

NEWS EDITORS

John F. King, Jesse J. Leaf

EDITORIAL PRODUCTION

Charles D. Ciatto (Mgr.), June Noto,
Jody LoGrasso

COPY EDITORS

Susan Levi Wallach (Chief), Jay J. Iorio,
Bill McIlvaine, Jim Taibi, Sherrie Van Tyle

ART

Sachiko Soskin (Associate Director),
Annmaria Palma

NEWS BUREAUS

Boston: Craig D. Rose (Mgr.), Debra Michals

Chicago: Wesley R. Iversen (Mgr.)

Dallas: J. Robert Lineback (Mgr.)

Los Angeles: Larry Waller (Mgr.), Ellie Aguilar

New York: Tobias Naegle (Mgr.)

Palo Alto: Clifford Barney (Mgr.),
Denise Caruso, Eve Bennett

Washington: George Leopold

Frankfurt: John Gosch (Mgr.)

London: Kevin Smith (Mgr.)

Paris: Robert T. Gallagher (Mgr.)

Tokyo: Charles L. Cohen (Mgr.), Mari Matsushita,

Michael Berger (World News Chief),

Jonathan Joseph

EDITORIAL ADMINISTRATION

Denise Giaimo (Administrative Assistant),
Laura Aspery, Ina Gruber, Josephine Ortiz

PUBLISHER

Laurence Altman

DIRECTOR OF OPERATIONS

Thomas E. Vachon

CIRCULATION MANAGER

Leon Irgang

PRODUCTION DIRECTOR

Thomas Egan

RESEARCH MANAGER

Elda Vale

CUSTOMER SERVICE MANAGER

Linda Tamburello

PUBLISHER'S LETTER

It's Wescon week, and nobody knows what that means better than our indefatigable New Products department—editor Steve Zollo and assistant editor Ann Jacobs. “Of the three shows that we showcase and give special attention to—the others are Electro and the National Computer Conference—Wescon means the most work for us,” says Zollo. “That’s because companies consider it the premier trade show, so it leads the others in product introductions,” (see p. 98).

He says the Wescon coverage in particular and covering new products in general make him feel like a puppeteer. “I pull the strings so that all parts of the process work in harmony.” The 29-year-old graduate of Old Dominion University gives the lion’s share of the credit for that effort to *Electronics*’ 11 domestic and foreign bureaus. “I couldn’t do it without them,” he says. “When the system works well, it shows off the beauty of our bureau system.”



WHAT'S NEW? Just ask Steve Zollo and Ann Jacobs.

Zollo is a native of Orange, N. J., who joined the staff in May 1981 after serving on a data-processing newsletter and working as a writer of software documentation. His office, without question the neatest one on the floor, also houses a lush collection of plants. His main hobby now is flying: he is building up his flying time in preparation for taking the flight test for a pilot's license.

Ann Jacobs, on the other hand, goes in for more down-to-earth pursuits when she is not working: her long-range plan for when she retires is to open a boutique and sell recreations of Victorian needlework. “I’m taking orders now,” she adds hopefully.

A self-described “47-year-old child wonder who kicked over from academic publishing to high tech,” Ann was born in Detroit and has worked for the University of Chicago Press (“I walked across the street to go to work there after graduating from the university”) and McGraw-Hill Book Co.

She started on *Electronics* in August 1984. “I took the job on the magazine so that I could learn to talk to my son, the programmer,” she jokes. “It certainly has improved family communication.”

Ann says her biggest headache comes from the sheer volume of product announcements—“including multiple copies of too many of them,” she adds. One thing she enjoys is talking to engineers. “They are always so eager to tell you what they know.”

Laurence Altman

November 18, 1985 Volume 58, Number 46
101,208 copies of this issue printed

Electronics (ISSN 0893-4989). Published weekly by McGraw-Hill Inc. Founder: James H. McGraw 1860-1948. Publication office: 1221 Avenue of the Americas, N. Y., N. Y. 10020; second class postage paid at New York, New York and additional mailing offices. Postage paid at Montreal, P. Q. Registration Number 9034.

Executive, editorial, circulation, and advertising addresses: *Electronics*, McGraw-Hill Building, 1221 Avenue of the Americas, New York, N. Y. 10020. Telephone (212) 512-2000. Teletype 12-7960 TWX 710-581-4879. Cable address: MCGRAW HILL L N E W Y O R K.

Subscriptions limited to professional persons with active responsibility in electronics technology. No subscriptions accepted without complete identification of subscriber name, title or job function, company or organization, and product manufactured or services performed. Based on information supplied, the publisher reserves the right to reject nonqualified requests. Subscription rates: the United States and possessions \$32 one year, \$55 two years, \$78 three years; company addresses and company libraries \$40 one year, \$67 two years, \$93 three years; Canada and Mexico \$34 one year, \$57 two years, \$78 three years; Europe \$50 one year, \$85 two years, \$125 three years; Japan, Israel, and Brazil \$85 one year, \$140 two years, \$200 three years; Australia and New Zealand \$95 one year, \$170 two years, \$240 three years, including air freight; all other countries \$50 one year, \$85 two years, \$125 three years. Limited quota of subscriptions available at higher-than-basic rate for persons allied to field served. Check with publisher for these rates. Single copies: \$3.00. Please allow four to eight weeks for shipment.

Officers of McGraw-Hill Information Systems Company: President: Richard B. Miller; Executive Vice Presidents: Frederick P. Jannot, Construction Information Group; Russell C. White, Computers and Communications Information Group; J. Thomas Ryan, Marketing and International. Senior Vice Presidents: Francis A. Shinal, Controller; Robert C. Violette, Manufacturing and Technology. Senior Vice Presidents and Publishers: Harry L.

Brown, Computers and Communications; David J. McGrath, Construction. Group Vice President: Peter B. McCuen, Communications. Vice Presidents: Fred O. Jensen, Planning and Development; Margaret L. Dagner, Human Resources.

Officers of McGraw-Hill Inc.: Harold W. McGraw Jr., Chairman; Joseph L. Dionne, President and Chief Executive Officer; Robert N. Landes, Executive Vice President and Secretary; Walter D. Serwatka, Executive Vice President, Publishing Services; Shel F. Asen, Senior Vice President, Manufacturing; Ralph R. Schulz, Senior Vice President, Editorial; George R. Elsingher, Vice President, Circulation; Ralph J. Webb, Vice President and Treasurer.

Title registered in U.S. Patent Office; Copyright 1985 by McGraw-Hill Inc. All rights reserved. The contents of this publication may not be reproduced in whole or in part without the consent of copyright owner. Where necessary, permission is granted by the copyright owner for libraries and others registered with the Copyright Clearance Center (CCC), 21 Congress Street, Salem, Mass. 01970, to photocopy any article herein for the base fee of \$0.50 per copy of the article plus \$0.25 per page. Payment should be sent directly to the CCC. Copying done for other than personal or internal reference use without the express permission of McGraw-Hill is prohibited. Requests for special permission or bulk orders should be addressed to the publisher, ISSN 0893-4989/85 \$0.50 + .25.

Subscribers: The publisher, upon written request to our New York office from any subscriber, agrees to refund that part of the subscription price applying to copies not yet mailed. Please send change-of-address notices or complaints to Fulfillment Manager; subscription orders to Circulation Manager, *Electronics*, at address below. Change-of-address notices should be addressed to the publisher, ISSN 0893-4989/85 \$0.50 + .25. Attach address label from recent issue. Allow one month for change to become effective. Subscriber Service: call (201) 356-7980, 9 a.m. to 4 p.m. EST. Postmaster: Please send address changes to *Electronics*, att. Fulfillment Manager, CN 808, Martinsville, N. J. 08836.

Editorial department phones: Administration (212) 512-2645, News and New Products (212) 512-2685, Technology (212) 512-2666. Bureaus: Boston (617) 262-1160, Chicago (312) 751-3811, Dallas (214) 458-2400, Los Angeles (213) 480-5234, New York (212) 512-6985, San Francisco/Palo Alto (415) 968-2712, Washington (202) 463-1650, Frankfurt 72-5566, London 493-1451, Paris 720-2070, Tokyo 581-9816. **Business departments:** (212) 512-3469 (Business departments follow the Advertisers' Index).

SERIES 32000 IS A TRADEMARK OF NATIONAL SEMICONDUCTOR CORPORATION.
UNIX IS A TRADEMARK OF AT&T BELL LABORATORIES.



"We did it!"

*"I knew we'd close that sale.
Did you see their faces?"*

*"It's our competitors' faces
I want to see. We've really cracked
this market now."*

*"Looks like we made all the
right decisions at the right
times."*

*"Like National's 32-bit
microprocessor family?"*

*"You can't build a system out
of data sheets and promises.
National had it, they delivered it,
and they got us here first."*

While you're still dreaming about success, Sequent is delivering it. With National's Series 32000 family.

On January 17, 1983, eighteen people started a new company called Sequent Computer Systems. They had no product, no plan, no backing. Only a dream.

Two years later, that dream came true. They delivered their first system—a sophisticated parallel processing computer. A full year ahead of their competitors.

How'd they do it? Hard work. Calculated risks. Belief. And a critical decision. They chose the Series 32000™ microprocessor family.

It offered them a *complete* 32-bit microprocessor family, including demand paged virtual Memory Management, Floating Point, and other peripherals with full UNIX™ support.

But the Series 32000 wasn't just the right engineering decision, it was the right *business* decision. It helped Sequent get their system to market fast. First.

Sequent hit their window of opportunity. And that window is still open—for now. So find out how the Series 32000 can help you build your own success story. Contact National Semiconductor today.

National's Series 32000, MS 23-200
P.O. Box 58090
Santa Clara, CA 95052-8090



**National
Semiconductor**
We're doing it.

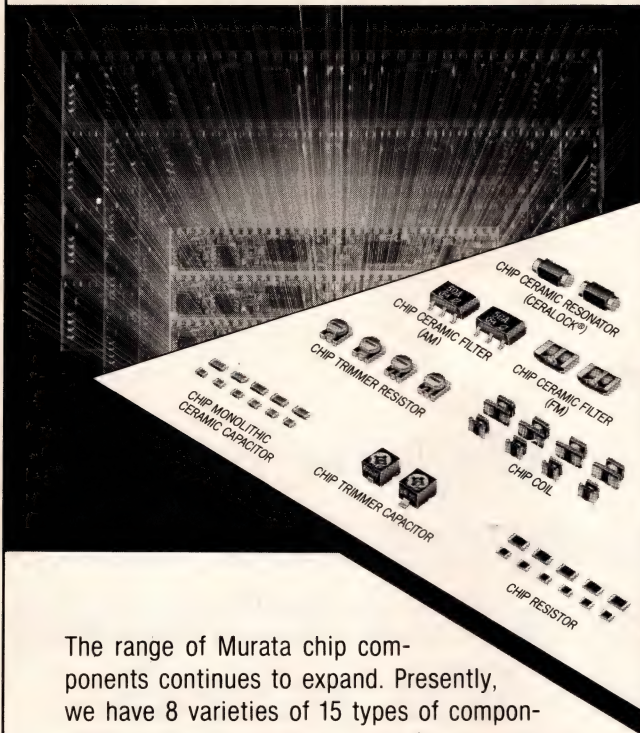


THE SUPERMINI ON A CHIP

Circle 7 on reader service card

A complete range of products with full features

Murata Chip Components



The range of Murata chip components continues to expand. Presently, we have 8 varieties of 15 types of components, and their many impressive features answer today's diversified needs for chip components.

- We offer the greatest variety of components in our field and are thereby helping to increase the mounting density of a variety of devices.
- In addition to paper and plastic tape and reels, we offer a all types of magazine and bulk packages.
- As FMS becomes increasingly important, we can assist you by offering our know-how for improving circuit board technology, and mounting equipment as well a packaging.



(U.S.A.) MURATA ERIE NORTH AMERICA, INC.
 3002 Kingston Court, S.E., Marietta, Ga. 30067, U.S.A. Phone: 404-953-1799 Telex: 542329
 (WEST GERMANY) MURATA ERIE ELEKTRONIK GMBH
 Kreuzsteinstr. 1A D-8500 Nürnberg 52. Phone: 0911-66870 Telex: 623763
 (FRANCE) MURATA ERIE ELECTRONIQUE, S.A.
 7,9., Rue Des Quarante Arpents 78220 Viroflay France. Phone: 03-024-6767 Telex: 699954
 (ITALY) MURATA ERIE ELETTRONICA S.R.L.
 Via Melchiorre Gioia 66, 20125 Milan, Italy. Phone: 688-4833/4835 Telex: 330385
 (ENGLAND) MURATA ERIE ELECTRONICS (UK) LTD.
 100 & 102 Albert Street, Fleet, Hampshire GU13 9RN England. Phone: 2514-21247 Telex: 858971

muRata MURATA MFG. CO., LTD.

HEADQUARTERS: Nagaokakyo-shi, Kyoto 617, Japan. Phone: 075-951-9111 Telex: MURATA J 64270
 MURATA ELECTRONICS SINGAPORE (PTE.) LTD. (Singapore) Phone: 2584233 Telex: 21127
 TAIWAN MURATA ELECTRONICS CO. LTD. (Taiwan) Phone: 04-291-4151 Telex: 31249
 MURATA COMPANY LTD. (Hong Kong) Phone: 0-4992020 Telex: 56208
 MURATA MFG. CO. LTD. Seoul Branch (Korea) Phone: 730-7605/730-7321 Telex: 25858

Circle 92 on reader service card

AVAILABLE!

1985-86 Electronics Buyers' Guide



Order your copy today for
the industry's most often-
used directory:

- It's three directories in one
- Includes more than 4,000 product listings (approx. 700 pages)
- Contains over 5,000 company listings (approx. 400 pages) including:
 - Company name, address and phone number.
 - Name and title of contact for sales information.
 - Number of engineers at plant and number of employees.
 - Annual dollar sales volume.
 - Local sales offices and manufacturers representatives.
 - Local distributors.
 - Instant referral to company's advertisements.
- Offers FREE current catalog retrieval service (approx. 1300 catalogs)

Price: \$50 per copy
(Add \$30 for air mail)

Send order with payment to:
Barbara Copcutt

Electronics Buyers' Guide

McGraw-Hill House
Maidenhead SL6 2QL,
England



Ever notice how some people always seem to have the right answer? No matter what the situation, they always seem to be a step ahead.

And they're successful...the first in line to lead an important project...the first in line for a promotion. It's certainly not magic. Usually it's a combination of hard work, brains, guts and desire.

It probably means they read Electronics ... regularly.

Electronics has helped propel many a manager and engineer to the front line...to the "leading edge" of the industry. And just as we've been providing many of your colleagues with the right information, the important information—when they need it most—so too can we provide it for you.

Every week an Electronics subscriber receives an issue crammed with the latest information on new products, developments, concerns and trends in the worldwide electronics industry.

When you become a subscriber, we'll supply you with the intelligence you need to make the big decision, or the every day decision to further your career and reap profits for your company. For a taste, just browse through the issue you're holding.

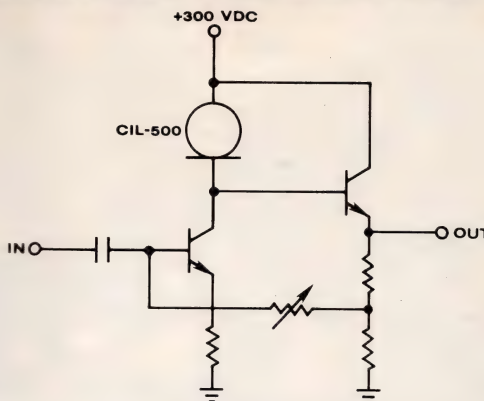
But, you really don't have to believe us. Just ask the person who's always a step ahead.

To become a subscriber, just complete and mail the insert card in this magazine. If subscription card is missing, write: Circulation Manager, Electronics, P.O. Box 511, Hightstown, N.J. 08520.

Electronics
The Voice of the industry



VERY HIGH VOLTAGE CURRENT REGULATORS



Teledyne Crystalonics is now delivering the CIL-500 series of current regulator diodes. The devices feature 300 Volt Peak Operating Voltage and are available in 36 standard increments from 0.22 to 6.8 mA. Packaged in either two or three leaded, hermetically sealed TO-5 packages, they are suitable for commercial, industrial and military/aerospace level applications.

The CIL-500 is constructed from the Crystalonics' high voltage JFET geometry and features very high dynamic impedance in addition to high POV.

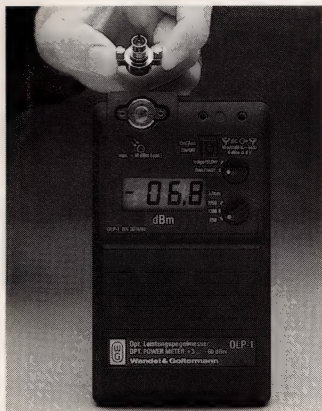
Send for data sheet and application notes.

TELEDYNE CRYSTALONICS

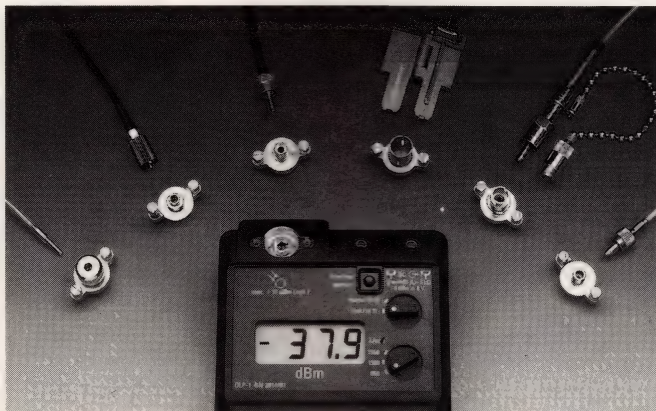
147 Sherman Street, Cambridge, MA 02140
Tel (617) 491-1670, TWX 710-320-1196

Circle 9 on reader service card

The practical optical level meter ★ no connector problems ★ covers all wavelengths and fibre types



Can't find the right connector? No such problems with the OLP-1 Optical Level Meter. There's an adaptor for practically every type of connector, even one for bare fibres!
Can't match the fibre type? Then try the OLP-1. Matches to all standard graded-index, monomode- and step-index fibres with core diameter $\leq 200 \mu\text{m}$; without the need for



switching, adapting or recalibration.
Got to change detectors? Not with the OLP-1. Just turn the switch to measure at 850 or 1300 or 1550 nm.
Difficult to use? The OLP-1 couldn't be simpler to operate: connect up, switch on, and read off the result. Display reads from -60 (-50) dB to $+3$ dB in one continuous range.

Accuracy is ensured by thermal compensation. No need to wait for things to settle down if the temperature changes!
On the move? As you'd expect, the OLP-1 can be used with dry batteries or a Nicad rechargeable battery; if you need to make long-term measurements there's also a mains adapter/charger. Battery check and auto-off circuits

ensure long, trouble-free operation. Why not get to know more about the OLP-1? It can be used for servicing, in the lab. Mains or battery operation. **Fill in the coupon for your copy of the detailed colour brochure** and make light work of your problems.

Information Coupon

I would like: EL/18.11.15
☐ a copy of the OLP-1 colour brochure
☐ a visit from a sales engineer

Name
Company
Address
Tel. No.

Wandel & Goltermann Inc.
1030 Swabia Court,
Imperial Center
Raleigh, N.C. 27709/USA
Tel. 919-544-5730
Telex 810-621-0002



In Europe contact: Wandel & Goltermann · P.O.B. 45 · D 7412 Enningen · Fed.-Rep. of Germany

Circle 93 on reader service card



DATELINE
FEB • 14
1993

"I'd worked on sub-micron designs for aerospace before. But my chip designs for ordinary mathematical calculations were nothing compared to

the ones we did for the Aborted Mission Retrieval System. These junk ships protect new space ships from floating debris.

"Basically, we had two problems: Minimizing fuel consumption, and real-time target recognition. The VHSICs had to identify and classify space debris, despite the tumbling and rolling.



"We simulated a lot of VHSICs on our Valid workstations. Valid provided everything we needed—schematic entry, logic simulation, even automatic chip layout. We solved design problems before we went to fab. With the Valid machines, the whole project went pretty fast. The VHSICs worked beautifully.

"Now I look up at night and

think, 'Wow, I helped create a whole new industry!'"

Started any new industries yourself, lately? If not, perhaps you should be working on a CAE system from Valid. After all, we created the CAE industry. And we're leading it, too. Right now, there are thousands of Valid workstations in place helping engineers like you create

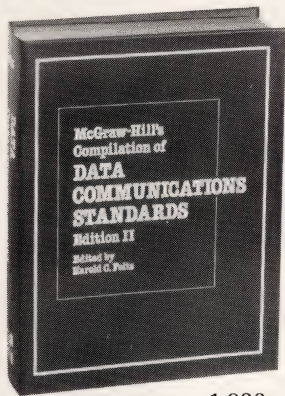
tomorrow's version of the world. Call us at 1-800-821-9441. In California, (408) 945-9400, Ext. 311. In Europe, call (011) 44-753-820101.

VALID
Designing the future

Circle 11 on reader service card

NEW EDITION

All standards
are new, revised,
or reaffirmed
since the
previous edition



1,923 pages
illustrated

Edited by Harold C. Folts

DATA COMMUNICATIONS STANDARDS

All 123 interface pro-
tocol standards set by:

- CCITT • ISO • ECMA
- ANSI • EIA
- U.S. Government

Special feature for instant
access to the applicable
standards:

Cross-reference tables of the
similar and interfacing
standards of each standards
organization.

Electronics Magazine Books
P.O. Box 541
Hightstown, NJ 08520
609/426-5070



Please send _____ copies
of R100-McGraw-Hill's *Compilation of
Data Communications Standards Edition
II* at \$295 each.

Name _____

Title _____

Company _____

Address _____

City/state/zip _____

U.S. customers please add local sales tax.
McGraw-Hill pays regular shipping and
handling on prepaid orders.

DC7

MEETINGS

COMPUTER PARLEY TO AIR EDUCATION GAP

ST. PETERSBURG, FLA.

The growing gap between engineering education and supercomputer technology will be one of four major topics at next month's First International Conference on Supercomputing Systems. And nearly everybody who's anybody in supercomputing will be there.

"College education is unable to satisfy industry requirements of supercomputing," declares Lana Kartashev, who with her husband, Steven Kartashev, chairs the conference. The industry is running 10 years ahead of curriculum, says Kartashev. She and her husband own Dynamic Computer Architecture Inc. in St. Petersburg.

At the education session, Ken Wilson of Cornell University will discuss ways to bring colleges up to speed, while Hisao Yamada of the University of Tokyo will present the Japanese view. Dennis

Parkinson of the University of London will give the European perspective, and Robert Dryden, president of Boeing Computer Services Co., will present an industry opinion.

The meeting will open on Dec. 16 with a day of tutorials. Four succeeding days will focus on training and education; assessment of international cooperation; industry initiatives; and architecture, memory, and software engineering.

Academic notables attending include Cornell's Wilson, a Nobel Prize winner in physics, Luigi Dadda of Milano Polytechnic University in Italy, and the University of Tokyo's Elichi Goto. Others attending include chief executive officers William C. Norris of Control Data Corp. and Koji Kobayashi of NEC Corp., plus Jean-Marie Cadiou, director of Europe's Esprit program, and Erich Bloch, director of the U.S. National Science Foundation.

1985 Power Semiconductor Devices Workshop, IEEE and National Bureau of Standards (Sandra B. Kelley, NBS, Building 225, Room B3444, Gaithersburg, Md. 20899), NBS Facility, Washington, Dec. 5.

IEEE-SISC: IEEE Semiconductor Interface Specialists Conference, IEEE (R. Daniel McGrath, Texas Instruments Central Research Laboratories, P. O. Box 225936, Dallas, Texas 75265), Bonaventure Hotel, Fort Lauderdale, Fla., Dec. 5-7.

1985 Videodisk, Optical Disk, and Compact Disk Conference & Exposition, Meckler Publishing (11 Ferry Lane W., Westport, Conn. 06880), Wyndham Franklin Plaza, Philadelphia, Dec. 9-12.

WSC '85: Winter Simulation Conference, IEEE *et al.* (Gerard C. Blais, U. S. Air Force, Washington, D. C. 20330), San Francisco Hilton and Tower, Dec. 11-13.

CAIA: Second Conference on Artificial Intelligence Applications, IEEE (Artificial Intelligence, 1730 Massachusetts Ave. N. W., Washington, D. C. 20036), Fontainebleau Hotel, Miami Beach, Fla., Dec. 11-13.

Winter National Design Engineering Show & Conference, Society of Mechanical Engineers (Cahners Exposition Group Inc., 999 Summer St., Stamford, Conn. 06905), Convention Center, Anaheim, Calif., Dec. 11-13.

24th IEEE Conference on Decision and Control, IEEE (David S. Spain, Advanced Information & Decision Systems Co., 210 San Antonio Circle, Suite 286, Mountain View, Calif. 94020-1270), Bonaventure Hotel, Fort Lauderdale, Fla., Dec. 11-13.

Expert Systems '85, British Computer Society (Conference Department, BCS, 13 Mansfield St., London, W1M 0BP, UK), University of Warwick, London, Dec. 16-19.

1st International Conference on Supercomputing Systems, IEEE (Supercomputing Conference, 1730 Massachusetts Ave. N. W., Washington, D. C. 20036), Innisbrook Resort, Tarpon Springs, Fla., Dec. 16-20.

ATE West '86, Morgan-Grampian Expositions Group (1050 Commonwealth Ave., Boston, Mass. 02215), Anaheim Convention Center, Anaheim, Calif., Jan. 6-9.

IC Assembly Automation Conference '86, Society of Automotive Engineers and Integrated Technical Marketing, (Intern, P. O. Box 390207, Mountain View, Calif. 94309), Red Lion Inn, San Jose, Calif., Jan. 8-9.

Hawaii International Conference on System Sciences, University of Hawaii *et al.* (Kim R. Lucak, College of Business Administration, University of Hawaii, 2404 Maile Way, C-202, Honolulu, Hawaii 96822), University of Hawaii, Honolulu, Jan. 8-10.

5th Symposium on Reliability in Distributed Software and Database Systems, IEEE (IEEE Computer Society, 1730 Massachusetts Ave. N. W., Washington, D. C. 20036), Los Angeles Marriott, Jan. 13-16.

Correction

A typographical error appears in the headline on page 17 of the Nov. 11 issue. It should have read "On-chip test design gets close to zero defects," as it does in the table of contents.

SIEMENS

Graphics Boards for AMS and SMP Systems

A picture is worth a thousand bytes

Alphanumerics displayed on terminals are usually precise and clear but sometimes you need much more.

By compressing large amounts of data into charts, curves or pictures you will obtain a quick overview, recognize changes and trends – you will stay in the picture.

With the new graphics boards 354 the AMS and SMP systems offer a cost-effective solution for such applications. This concept is based on open and standardized hard- and software interfaces. These features assure the future of your system.

Here are the most important characteristics of the AMS-M354 and SMP 354:

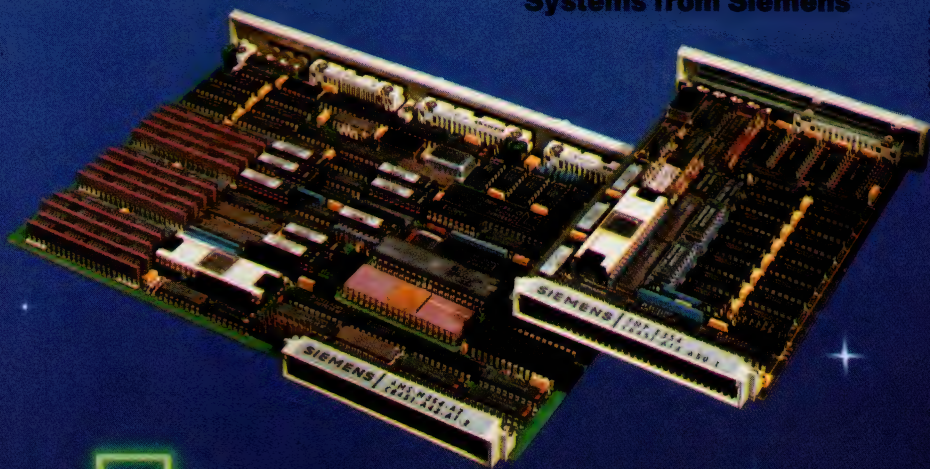
- display formats 1024 by 1024 pixels for AMS and 512 by 512 for SMP
- eight colors
- frame rates up to 70 Hz, non-interlaced
- software driver included in delivery

In addition AMS-specific features:

- local processing capabilities, using two 8 MHz processors
- standardized graphics software – the Graphical Kernel System GKS.

For additional information please contact our local Siemens office or Siemens AG, Infoservice 12/1234, Postfach 2348, D-8510 Fürth, "Graphics Board Systems for AMS and SMP".

**AMS, SMP, PMS –
the Microcomputer Board
Systems from Siemens**



12/1234.101

Circle 94 on reader service card

WEEK 4

Our new Am2968 Dynamic Memory Controller delivers clean, correct data, without a speed penalty, because of the way it lets you scrub every word.

No bull.

It's the only controller available that supports scrubbing. That's the novel technique that cleans up errors during refresh, without stealing precious processing time from the CPU.

What's more, with an Am2968, the cleanliness of the data is only exceeded by one thing:

The cleanliness of your design.

That's because you no longer have to work around rigid single-chip, state machine designs.

Or cuss at them, either.

Am2968

Stop using dirty words.

The Am2968 is one of a family of memory support products. And by mixing and matching, you can now select the levels of control, timing and error detection that best meet your system requirements.

The Am2968. Use it to improve your memory.

And your language.

WEEK 5

From now on, let a new 80188 microprocessor do the thinking in your system. Ours.

You can switch to our plug-compatible LCC version, without changing one bit of your design, or to our exclusive PLCC version, and conserve both board space and cost.

80188

Change how you think.

But don't think of our 80188 as merely another source of the world's most cost-effective 8-bit microprocessor.

Instead, think of it as your way of benefiting from our continuing commitment to expand the popular iAPX86 family (something you'll appreciate if you're already buying 8086s and 8088s from us).

A commitment that extends not only to the CPUs, but also to the peripherals that make them play.

And a commitment that will continue with our upgraded 10MHz 80188, available from us next quarter.

So, if you want to improve your designs, you don't have to change the world. Just the way you think.

WEEK 6

Our new Am2864B will wipe all other 64K EEPROMs from your mind.

Thanks to its unique page mode, which writes from one to 32 bytes at a clip, an Am2864B programs up to 32 times faster than other EEPROMs. Forget about this chip being a drag on system performance.

And with its matching 250ns cycle and access times (300ns for the military version), you can recall the data quickly enough for the most demanding designs.

Am2864B

Erase old EEPROM memories.

In addition, features like your choice of a ready/busy pin, or data bar (data) polling on all data lines, make design-in a snap. And make upgrades from existing designs as painless as possible.

For example, you can replace our Am2817As with Am2864Bs without performing major surgery. And eventually replace Am2864Bs with the 256Ks just over the horizon.

Best of all, this performance can be yours even if you're using Brand X parts. Because the Am2864B is pin and function compatible with every one of today's 64K EEPROMs.

Byte for byte, it's the most advanced EEPROM available from any semiconductor supplier.

And the best 64K in anyone's memory.

WEEK 7

Just add our Am8177 16-bit Video Data Serializer to your system and convert pixel data from parallel to serial, instantly.

Instantly? Instantly.

Its 200MHz shift rate is the fastest available. From 1K x 1K screens on up, no other single-chip design can touch the Am8177's high resolution performance.

Or its flexibility. With a minimum of effort, multiple Am8177s can be cascaded to form a shifter as wide as your pixel words.

Am8177

Instant serial.

Plus, there's nothing extra to build, buy or debug. From input latches to finicky TTL/ECL interfaces, all the logic you need is onboard.

One of our family of bit-mapped graphics components, the Am8177, is the high-performance way to serialize screen data.

Taste the chip that eats its competitors for breakfast.

We're putting our mouth where our money is.

Advanced Micro Devices is introducing fifty-two new products over the next year. One a week. Every week. On the shelf. In volume.

Microprocessors, microcontrollers, gate arrays. SRAMs, DRAMs, EPROMs, EEPROMs, to name a few. Plus the blue chips: ISDN, graphics, networking. All VLSI.

This program isn't a sudden whim. It's the direct consequence of R&D blood, sweat and money—more dollars as a percent of sales than anyone else in this business.

Some things never change. This year Advanced Micro Devices will spend more on R&D than last.

Meanwhile, fifty-two new products. One a week. Every week. On the shelf. In volume.

That's not a promise. There are too many promises in this business. That's a commitment.

The International Standard of Quality guarantees a 0.05% AQL on all electrical parameters, AC and DC, over the entire operating range.

INTSIL 9001



Advanced Micro Devices

For more information, contact the sales agent nearest you or write the word "Seven" on your letterhead and mail to Advanced Micro Devices, Mail Operations, P.O. Box 4, Westbury-on-Trym, Bristol BS9 3DS, United Kingdom.



**Stop
Oscillator**

**Stop
Clock**

Slow

**Full
Speed**

Street-wise designers: use the ultimate in speed and power control.

New Harris 82C85 Static Clock Controller operates in four low- power modes.

The new Harris 82C85 static CMOS clock controller/generator dramatically reduces power consumption in static CMOS systems by giving you four distinct operating modes.

- Full Speed for top performance.
- Slow mode for low power and continuous operation.
- Stop Clock for low power and instant restart.
- Stop Oscillator for minimum power standby operation.

Designed specifically for 80C86 and 80C88-based systems, the 82C85 responds to a software HALT command, stopping all system clocks automatically. The 82C85 can also be controlled by a flexible independent START and STOP control structure.

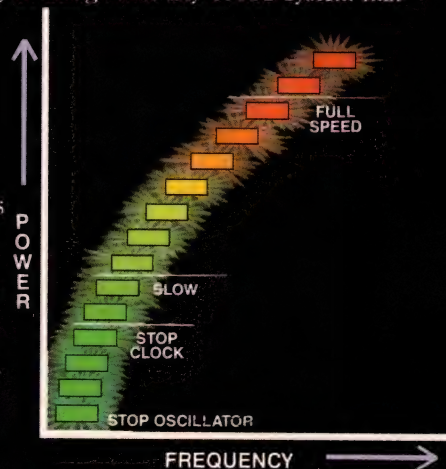
With a full DC-8MHz operating frequency range, the 82C85 allows you to control your system power and performance, tailoring them to your exact requirements.

Stop...With no loss of data! Accelerate...With no delay!

It's the control you've been waiting for — for your portable instrumentation, industrial process control or military guidance systems. In fact, it's easy to design into any CMOS system that needs extremely low operating power.

The new Harris 82C85 static CMOS clock controller/generator — the next generation of system control from the world's leader in 16-bit CMOS microprocessors.

Contact: Harris/MHS Semiconductor Sales Ltd., Eskdale Road, Winnersh, Wokingham, Berks, RG11 5TR, England.



Harris Semiconductor: Analog - Bipolar Digital
CMOS Digital - Gallium Arsenide - Semicustom - Custom

 **HARRIS**

For your information, our name is Harris.

Circle 97 on reader service card

TECHNOLOGY NEWSLETTER

61.4-GIGAFLOPS SUPERCOMPUTER IS IN THE WORKS

A research team at Princeton University is developing what could be the world's most powerful supercomputer. With funding from two National Aeronautics and Space Administration research labs, the group has designed a machine with up to 128 nodes that it claims will reach a peak speed of 61.4 billion floating-point operations per second and a sustained performance of 51.2 gigaflops. To connect the nodes, the Princeton group, under Dan Nosenchuck, used a subset of the Cosmic Cube architecture developed at the California Institute of Technology. The team designed a fast 16-by-16-by-32-line switching mesh to transfer data between adjacent nodes. The result is a network that adds no overhead for interprocessor communication. A node will use up to 24 Am29325 32-bit emitter-coupled-logic floating-point processors running at 20 MHz. Each node runs at a sustained 400 megaflops, 480 megaflops peak—roughly three times the peak speed of Cray Research Inc.'s Cray-1. The Princeton group is building a four-node prototype network. □

CMOS AND BIPOLAR JOIN FORCES IN TI 32-BIT CHIP SET

L eading-edge technology in both bipolar and CMOS logic will team up in a new 32-bit microprogrammable processor chip set, to be unveiled by Texas Instruments Inc. at this week's Wescon '85 show in San Francisco. The 32-bit 74AS8832 series is upwardly compatible with TI's 8-bit AS888. When available in 1986, the set will be about twice as fast as TI's 8-bit-slice processors, thanks to new 1.5- μ m bipolar and 1- μ m CMOS technologies. The 1- μ m CMOS, developed for 1-Mb dynamic random-access memories, will be used on two 8832 family members—a 32-bit multiplier-accumulator and 64-bit floating-point processor. Impact-X bipolar technology, which ups density with new oxide-isolation techniques, will be used on a 32-bit arithmetic-logic unit, a 32-bit barrel shifter, a 64-bit funnel shifter, a register file, and a 16-bit microcontroller. Look for TI to introduce in December a 10-ns programmable logic array made with Impact-X technology. □

OPTICAL AIMING MAY COME TO LASER ARRAYS

D irect aiming and scanning of a diode-laser array without acousto- or electro-optic aids could soon be possible. For the first time, the beam angle of these arrays has been optically controlled, say researchers at the Sandia National Laboratories, Albuquerque, N. M. They have used injection-locking techniques to scan an array's output beam over an angle of several degrees. When they used a single-frequency, tunable, continuous-wave dye laser as the master oscillator for a commercial 10-element 100-mW array, the array stayed locked over a band 60 MHz wide, an eightyfold improvement over previous experiments. The group says these techniques can be used with larger arrays for military and commercial applications. □

NTT IS SETTING UP A SYNCHROTRON-LITHOGRAPHY FACILITY

N ippon Telegraph & Telephone Corp.'s Atsugi Electrical Communication Laboratories has started work on its \$100 million synchrotron orbital-ring lithography facilities, to be completed in March 1988. The complex's clean rooms are designed for fabrication of dynamic random-access-memories larger than 64 Mb with design rules of about 0.2 μ m. The rooms will rate better than Class 1, defined in Japan as less than one 0.5- μ m particle per cubic foot of air. Synchrotron lithography is a form of X-ray lithography, with two distinguishing features—radiation is parallel rather than diverging, and wavelengths from 5 to 10 Å can be used. NTT developed the relatively small 5-meter-diameter synchrotron with Hitachi Ltd. and Toshiba Corp. □

No One Should Have To Settle For A Mid-Range Tester That Can't Ever Be Anything More.

Some companies make no bones about asking you to spend \$150,000 or more on a mid-range tester that you'll outgrow in a year or two.

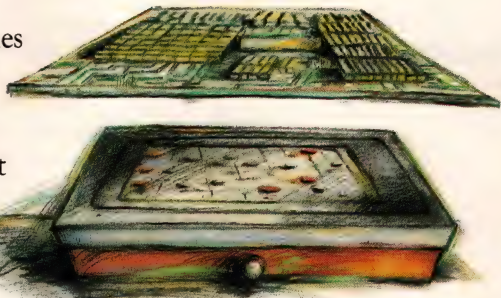
At GenRad, though, we gave our 2276 in-circuit test system the one option you won't find on other testers.

A future.

In any configuration, the 2276 gives you twice the data rate and four times the memory depth of most other testers. When fully expanded, it gives you a 20 MHz clock and the only full-cell, 1-megabit memory tests in the industry. And when you add the J-11™ processor option, you can cut test time by as much as 50 percent.

So why settle for a mid-range tester that takes you nowhere. When you can have one that takes you anywhere you want to go.

For more information, call 1-800-4-GENRAD. Or write GenRad, 170 Tracer Lane, MS13, Waltham, MA 02254.



GenRad®

ELECTRONICS NEWSLETTER

MOTOROLA QUILTS n-MOS 256-K DYNAMIC RAM BUSINESS

Motorola Inc. has decided to leave the 256-K dynamic random-access-memory business because of what it calls "pricing practices with predatory consequences" by Japanese makers, some of which quote prices in the \$2 range. It will continue to make CMOS DRAMs, with a 256-K chip scheduled for sample quantities early in 1986 and first silicon of a 1-Mb model in the first quarter of next year. The move leaves Texas Instruments Inc. as the sole U. S. manufacturer of n-MOS 256-K chips. □

FOUNDER LEAVES APOLLO COMPUTER

John W. Poduska, founder and chairman of Apollo Computer Inc., has resigned to start a company that will build work stations in the 20- to 30-million-instruction/s range. The work stations will be built entirely of application-specific integrated circuits and will sell for \$50,000 to \$100,000, Poduska says. He expects to take 15 months to develop the products and says that they will be easy to integrate in Apollo Domain networks.

Meanwhile, Apollo, in Chelmsford, Mass., will broaden its line by integrating parallel-processing computers into its networks. The processors will come from Alliant Computer Systems Corp. of Acton, Mass. Apollo also is investing \$3.8 million in Spectragraphics Corp., San Diego, to fund development of links to IBM Corp. mainframes. □

FUJITSU COMPUTER ENTERS PURSUIT OF IBM 3090

Japan's Fujitsu Ltd. has entered the field of mainframe makers that are chasing IBM Corp.'s 3090 computers. The Tokyo company has unveiled a series, the M-780, that places the entire central processing unit on a single board for added speed. For instance, Fujitsu claims that its four-processor model has twice the throughput of IBM's 3090/400 for a mix of business and scientific programs; dual- and single-processor configurations will have roughly the same processing power as the 3090/400 and 3090/200, respectively. Throughput is about 1.7 times that of Fujitsu's current M-380 computers, which customers will have to continue using for some time: shipments of single-processor M-780s aren't scheduled to start until March 1987, almost a year behind the 3090/400. □

AT&T DESIGN CENTERS MARK ENTRY INTO ASIC MARKET

Two newly announced design centers, now open in Munich and Sunnyvale, Calif., mark AT&T Co.'s official entry into the crowded commercial market for application-specific integrated circuits (see related story, p. 87). By the second quarter of 1986, the centers will be using 1.25- μ m CMOS design rules with the company's standard-cell libraries. □

DOES LATEST BOOK-TO-BILL RATIO INDICATE INDUSTRY RECOVERY?

Despite a gain in the semiconductor industry's monthly performance chart, the book-to-bill ratio, industry analysts still are cautious about predicting a recovery for the slumping chip makers. The ratio hit 0.82 : 1 in October, up from 0.76 : 1 in September and its highest mark in more than a year. Billings in October were actually down 14%, to \$573.1 million, says the Semiconductor Industry Association in making the new figures public. "The ratio will continue to go up only because billings will continue down," says Dean Winkelmann of Integrated Circuit Engineering Corp., Scottsdale, Ariz. With delivery schedules stretched out into 1986, "it is too early to forecast the rate of improvement in shipments," the SIA says. □



Actual unretouched video image of Fred Molinari, President.

"It's easy to spot the difference between our IBM PC™-based frame grabber and the others."

High performance and affordable cost, just \$1495 for a single plug-in board.

Unlike other video I/O systems, the new DT2803 provides real-time image capture capabilities, digitizing a 6-bit video field every 1/30 second. An on-board, memory-mapped, dual-ported frame store memory (256 × 256 × 8) makes it ideal for the IBM PC's 64K buffer size. And for real number crunching,

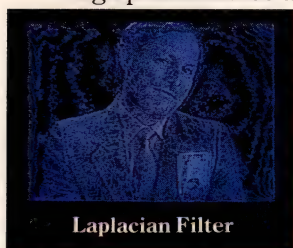
the DT2803's external ports interface to high speed co-processors.

With our software package, VIDEOLAB™, the DT2803 is easy to use for image operations like averages, histograms, and convolutions.

So, if your application is manufacturing/automatic inspection, robotics, or medical research,

our new high performance video I/O board will really open your eyes—at an unbeatable price.

Call (617) 481-3700



Laplacian Filter



False Color



Call for our new 576 pg. catalog/handbook or see it in Gold Book 1985.

SPECIFICATIONS: DT2803

A/D Input	RS-170 (CCIR), 6-bits at 5MHz
Frame Grab	1/30 (1/25) second per field
LUT's	8, 64 × 8 input; 4, 256 × 12 output
D/A Output	64 colors × 64 intensities, R-G-B; 64 grey levels, monochrome
Frame Memory	256 × 256 × 8 (2-bits for graphic overlays)

DATA TRANSLATION

World Headquarters: Data Translation, Inc., 100 Locke Dr., Marlboro, MA 01752 (617) 481-3700 Tlx 951 646.

European Headquarters: Data Translation, Ltd., 13 The Business Centre, Molly Millars Lane, Wokingham Berks, RG112QZ, England Tlx: 851849862 (#D)

In Canada: (416) 625-1907.

IBM PC is a registered trademark of IBM. VIDEOLAB is a registered trademark of Data Translation, Inc.

Circle 20 on reader service card

PRODUCTS NEWSLETTER

HIGH-CAPACITY 5¼-IN. DRIVES EMBED THEIR CONTROLLERS

Two disk-drive makers are embedding the controllers in high-capacity Winchester drives, thanks to highly integrated controller chip sets and surface-mounted devices. The drives, from San Jose, Calif., neighbors Maxtor Corp. and Priam Corp., feature full SCSI implementations. The XT-3000 family from Maxtor, to be available early next year, has capacities of 170 or 280 megabytes with average access times of 30 ms. Maxtor won't quote actual prices but says the drives will cost about \$10 a megabyte. The Priam model 725 with a 255-megabyte capacity is slated to be in volume production in the second quarter of 1986 and features a 20-ms average access time. In 1,000-piece quantities, it will sell for \$2,185 each. The companies are showing their new drives at Comdex this week in Las Vegas. □

FAST ION-DEPOSITION PRINTERS GO TO MARKET

Watch for a surge of interest in ion-deposition printers now that C. Itoh Electronics Inc. and Xerox Corp. are adding that technology to their printer lines. At this week's Comdex show in Las Vegas, the Los Angeles affiliate of C. Itoh Electronics Japan Co. will introduce 35- and 45-page/min printers using a new engine that it developed with the originator of ion deposition, Delphax Systems, Westwood, Mass. Xerox, of Stamford, Conn., which owns 50% of Delphax, will reportedly introduce a 60-page/min ion-deposition printer in Europe this week. In ion-deposition printing, the printing mechanism forms charged latent images by projecting ions onto a dielectric drum; the images attract a toner that is then transferred to plain paper. C. Itoh's CIE 3000 line, which will be priced starting at under \$15,000, is set to challenge 10- to 20-page/min laser printers and line printers in the 2,000- to 3,000-line/min range. □

PABX LINKS COMPUTERS AND TERMINALS OVER PHONE WIRE

Data switching for 2,016 channels in large local networks is offered by Micom Systems Inc.'s new Instanet6600 Data PABX. The Simi Valley, Calif., firm says the Data PABX uses standard telephone wiring and connectors to link computers and terminals at speeds to 19.2 kb/s. A 120-user system sells for \$16,500, or about \$137 per user. The new exchange features built-in gateways to X.25 packet data networks and protocol conversion that permits personal computers to access IBM mainframe computers. □

TRIQUINT ADAPTS GaAs LIBRARY TO DAISY SYSTEMS

Triquent Semiconductor Inc. has adapted its semicustom gallium arsenide library to Daisy Systems Corp.'s schematic-capture, logic-simulation, and verification software. Triquent's Q-Chip macro library can turn out logic circuits of medium-scale complexity—up to 140 gates. The new software costs \$4,000 and is available through all Tektronix Inc. field offices. Triquent of Beaverton, Ore., is a Tektronix spinoff formed to make GaAs ICs. □

VERDIX TAILORS ADA TO SEQUENT'S PARALLEL COMPUTER

What is claimed to be the first computer to support multiple-user Ada applications is the result of cooperation between Sequent Computer Systems Inc., Beaverton, Ore., and Verdix Corp., Chantilly, Va. Verdix will now sell and support its VADS (Verdix Ada Development System) for use on Sequent's Balance 8000 parallel computer. VADS includes a high-speed Ada compiler and development set. Basic Balance 8000 systems come configured with from 2 to 12 32-bit processors. □

WE JUST WON THE BATTLE OF MIL-STD-1750A.

You're looking at the only microprocessor chip set to complete the MIL-STD-1750A (Notice 1) VSW certification.

The new MDC281 is a general-purpose, 16-bit microprocessor module which consists of three CMOS/SOS Large Scale Integrated Circuits on a single plug-in assembly. These three chips form a basic CPU capable of directly addressing instructions and data within 64K words of memory.

At the heart of the module, the execution chip performs calculations. The

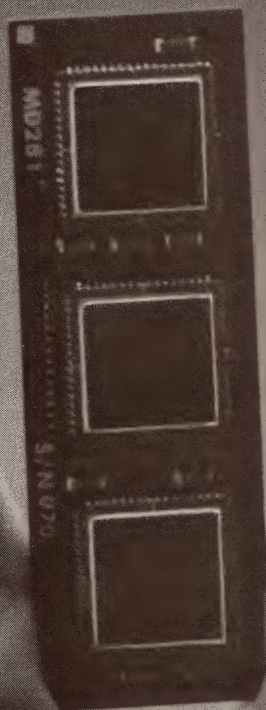
control chip contains the microcode and controls machine execution sequences. A third chip services interrupts, machine and system faults, and system timers.

We've designed our new CPU primarily for military applications requiring real-time information processing, including sensor data processing, and for weapon system control and operation. It's especially suitable for embedded applications in small systems—wherever there are size, weight and power limits. The MDC281 performs across the MIL temperature range on less than two watts.

We'll ship prototypes this year, and production models next year. Right now, contact us for more information and complete specifications. Call (314) 234-8040. Or write to McDonnell Douglas Microelectronics Center, Marketing, M002/111, P.O. Box 516, St. Louis, MO 63166.

We won the battle, but you're the real winner.

**MCDONNELL
DOUGLAS**



Electronics

PARALLEL-PROCESSING ENGINES MOVE INTO DESKTOP COMPUTERS

TWO COMPANIES' ICs WILL TURN THE IBM PC INTO A NUMBER CRUNCHER

DALLAS

Number crunching could soon take a quantum leap down in cost: two companies are separately preparing hardware that will turn an IBM Corp. Personal Computer into a multiple-processor parallel engine. These efforts to apply multiprocessing to the PC are coming from two companies that are as diverse as the field of vendors competing for parallel-processing sales [*Electronics*, Oct. 28, 1985, p. 32].

The plug-in parallel-processing boards are being promised by \$14 billion ITT Corp. and a two-year-old startup in Beaverton, Ore., called Ncube Corp. Though both companies are building boards with highly integrated custom circuits, Ncube's boards are multiple-instruction, multiple-data-stream (MIMD) machines, and ITT's are based on single-instruction multiple-data (SIMD) architecture.

The first working system comes from Ncube, which this week will introduce its board along with larger parallel computers (see story, p. 24) at the meeting of the Society for Industrial and Applied Mathematics in Norfolk, Va. "We call it system-driven VLSI," says chairman John F. Palmer, referring to Ncube's very large-scale integrated 32-bit processors. The 2.5- μ m n-MOS chips, 400 mils on a side, contain error checking and correction, direct-memory-access channels, and a 32/64-bit floating-point coprocessor.

All that's needed to make a processing node is one Ncube integrated circuit and six 256-K dynamic random-access memories. The Ncube processor, made by VLSI Technology Inc., will not be put on the market, says Palmer. However, Ncube will sell a four-processor card for the IBM PC AT, starting in 1986. The PC AT's

80286 microprocessor drives the peripherals and provides the user interface.

Up to four Ncube/four boards may be loaded into the PC AT's slots, says Palmer. A small cable is plugged into connectors located on top of the boards, creating 16-node Hypercube processors interconnected by a three-dimensional network that promotes fast message passing among one node and its four adjacent neighbors. Each board potentially boosts floating-point processing performance to 20 times that of a PC AT with an 80287 coprocessor. Palmer says the boards are primarily for using PCs as software-development stations for Ncube's larger parallel systems. "However, some original-equipment manufacturers might do their own software package to use it as a raw PC accelerator," admits Palmer.

PC acceleration, however, is precisely the focus of ITT's massively parallel Personal Supercomputer Coprocessor, slated for an early 1987 debut. The plug-in board is under development at ITT's Advanced Technology Center in Shelton, Conn. The objective is to provide peak performances equaling two thirds of a 64-bit Cray-1 supercomputer. The board will handle more than 120 million 32-bit floating-point operations per second and provide more than 100 Mb/s of external

input/output bandwidth, promises Steven G. Morton, staff scientist.

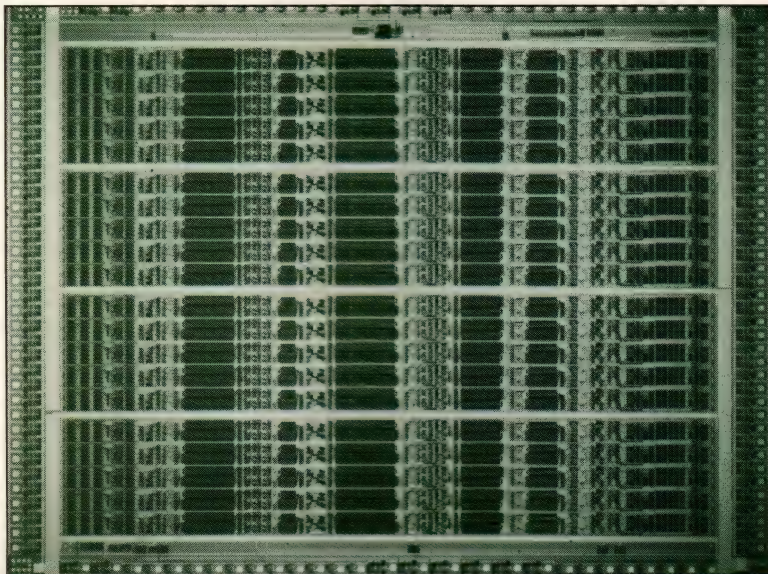
Next month, the ITT center will demonstrate the underlying IC technology and system architecture with a first-generation 16-bit prototype. The SIMD architecture is built from 36 reconfigurable, fault-tolerant, bit-slice chips, known as cellular array processors, or CAPs. The four-year project focuses on a range of parallel-processing products, including a second-generation bit-parallel microprocessor slated to be the basis of ITT's system products by 1987, one of which is likely to be a full-motion color picture phone, says Morton.

NEGOTIATIONS. ITT is currently negotiating with an interested IC merchant to put the chip on the market, says Morton. ITT is also seeking interested partners to jointly develop and market parallel-processing systems based on the second-generation CAP circuits.

The first-generation CMOS device, described by Morton as a processor made of 16 functioning 1-bit-slice cells, is large: 500 by 650 mils. But ITT is getting about 25% production yield one month after its first working silicon. Because defects are almost certain on huge chips, ITT is using large-area-integration manufacturing techniques, which use routing software and four

spare cells to replace bad areas. Morton notes that ITT's CAP can also repair itself in the field.

"One technique covers birth defects, and the other is a dynamic self-repairing technique, taking care of aging defects," he adds. Initial working versions of the second-generation CAP chip are expected in the third quarter of 1986. The 144-pin first-generation part has 20 1-bit-slice cells. "The second will have a lot more than that," he says. Topping the list of future ITT parallel-processing products is the PC coproces-



THE CAP. ITT's cellular array processor is a 144-pin IC with 20 1-bit processors.

sor board, which will handle variable word sizes of 16 to 256 bits and deliver better than 2 billion 16-bit operations/s. It will cost about \$10,000.

In addition, Inmos International plc, Bristol, England, reports several unidentified customers have begun designing parallel-processing boards for PCs based on the 32-bit transputer [*Electronics*, Oct. 7, 1985, p. 20]. Inmos's chip contains four communications channels, which form transputer-to-transputer links for parallel processing. —J. Robert Lineback

COMPUTERS

CAN DATA GENERAL CATCH UP AGAIN?

BOSTON

Data General Corp.'s introduction this week of new work stations and a high-end superminicomputer, all of which are critical to the company's future growth, continue its habit of being late with major products yet pricing them aggressively below the competition's so they can quickly penetrate the

market. This time around, however, Data General's products have more ground than ever to make up because of the earlier, fast start made by competitive products from archival Digital Equipment Corp.

Data General's work station will run software developed for the company's MV line and will be priced below competing machines. Its new high-end machine, which uses gate arrays throughout its architecture and can execute 5 million instructions per second, will also improve on existing price-performance levels of the Westboro, Mass., company's machines [*Electronics*, Nov. 11, 1985, p. 13].

These offerings are positioned against DEC's MicroVax II and VAX 8600 work stations. DEC has sold 5,000 MicroVax IIs since its spring introduction and more than 1,000 high-end VAX 8600s during its first year.

The high end, however, may soon see even tougher competitors than the 8600 and DG machines, suggests George Colony, president of Forrester Research, a market researcher in Cambridge, Mass.

Similarly, Stephen K. Smith, an analyst at Paine Webber Inc., New York, suspects that DEC deliberately con-

strained the performance of its MicroVax II so as not to eat into its own low-end sales—thus a MicroVax III with enhanced performance would be a relatively quick and easy project.

SLOWER DECISION. Data General's latest product delay may not hurt that much because the company draws a growing percentage of revenue from office-automation products. "The technical guy is more likely to run out and buy the fast box," says David Moschella, senior analyst at International Data Corp., Framingham, Mass. "The office guy will take time to decide if it's something he wants to live with for five years."

The bottom line will be whether the new products can expand Data General's customer base. In addition, the company is seeking to rebound from the disappointing sales of its DG/One, the laptop computer, compatible with the IBM Corp. Personal Computer, that has had multiple price cuts in a year.

This week's array of new product announcements could fill the bill, but early betting is that Data General will do no better than hold its own. Says Colony of Forrester Research, "This is strictly damage control." —Craig D. Rose

A ROUTE TO DENSER MULTIPROCESSORS

TEMPE, ARIZ.

Astartup founded by three former Intel Corp. engineers has integrated on one chip all the logic needed for a fully functioning 32-bit node inside a Hypercube-based data-flow parallel processor. Integration of the logic is expected to drive down the cost of Hypercube machines while boosting the reliability of multiprocessor systems.

The proprietary 32-bit microprocessor, along with 256-K memories, will build a 3-ft-high parallel computer with impressive performance figures: up to 500 million floating-point operations/s and 2 billion 32-bit operations/s.

Ncube Corp. will introduce the multiple-instruction, multiple-data-stream machine this week at a meeting of the Society for Industrial and Applied Mathematics in Norfolk, Va. It is an implementation of the Hypercube interconnection scheme based on the Cosmic Cube architecture pioneered at the California Institute of Technology [*ElectronicsWeek*, Oct. 8, 1984, p. 29]. A minimum configuration of 16 nodes costs \$100,000, and a fully loaded Ncube/ten with 1,024 processors is about \$2 million, says John F. Palmer, the Beaverton, Ore., company's chairman and cofounder with president Steve Colley and vice president

William Richardson.

Palmer describes the parallel-processing system as a "medium-grain data-flow architecture." There is no program counter for the entire system, but each seven-chip node is a control-flow processor with its own program counter.

Ncube has developed two operating systems that run in parallel but in separate parts of the computer. Axis—a multiuser operating system modeled on AT&T Bell Laboratories' Unix—runs on an Intel 80286 host processor. It handles the disk access and the user interface.

A second operating system, called Vertex, runs on the Hypercube 32-bit nodes inside the processing array. Ver-

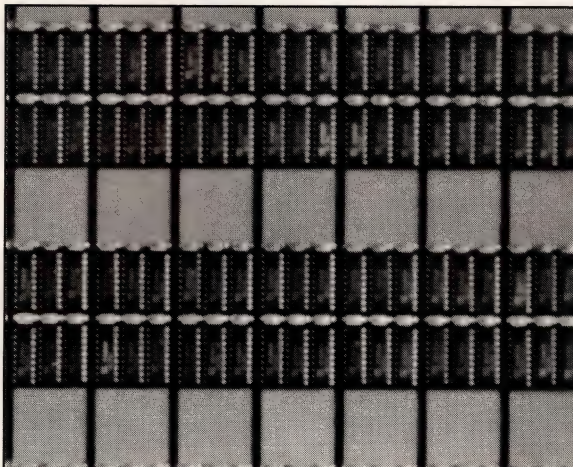
tex provides communication facilities, debugging, and process management.

Ncube set out to reduce the chip count per node to only seven integrated circuits to increase system reliability, reduce programming complexity, speed up input/output, and lower costs and system size. The very large-scale integration will make it possible for Ncube to offer a plug-in four-processor board for IBM Corp.'s Personal Computers (see story, p. 23).

Each processing node has an Ncube chip and six 64-K-by-4-bit dynamic random-access memories. "We believe the best way to design a parallel computer is to start with a system definition and then integrate the right parts. . . . The ideal is to integrate everything but memory," Palmer says.

The custom IC contains some 160,000 transistors on a die measuring 400 mils on a side. It not only contains a central processing unit for 8-, 16-, and 32-bit integer operations, but has on-chip 32- and 64-bit floating-point units. Each Ncube system node can execute up to 0.5 megaflops.

The 68-pin custom processor also has integrated error-correcting code and 22 direct-memory-ac-



PACKED. Processing nodes fit together like bricks on an Ncube board.

cess channels capable of independent operation while the chip's CPU processes programs. Ten pairs of 10-Mb/s inbound/outbound DMA channels communicate with the nearest neighbors on the Hypercube network. One DMA-channel pair attaches each node to the system-I/O board. From the six DRAMs, the processor fetches 16-bit data words plus 6 bits of error-correcting code (2 bits are unused).

Ncube can pack 64 nodes of 32 bits each on each 16-by-22-in. processor

board. The Ncube/ten computer can carry 16 of these boards, which cost \$100,000 apiece. The Ncube cabinet may also house a number of I/O boards, including a host-system board, which contains 16 Ncube chips and costs \$60,000.

Ncube has delivered several beta-test-site units to customers, including Shell Development Co. in Houston, Oak Ridge National Laboratories, Oak Ridge, Tenn., and the University of Michigan's Advanced Computer Architecture Laboratory.

—J. Robert Lineback

SEMICONDUCTORS

VERTICAL FET GIVES NTT TWICE THE CHIP DENSITY

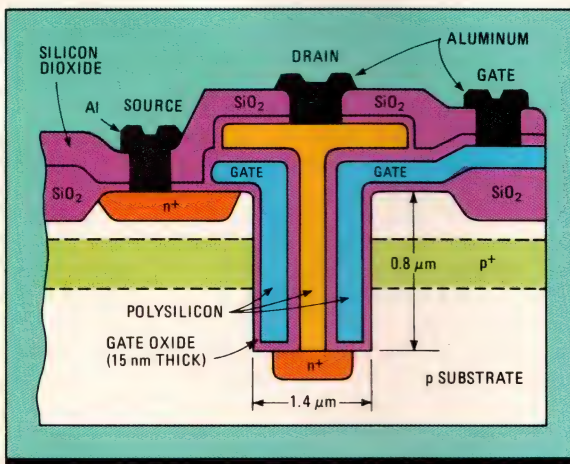
ATSUGI, JAPAN

The vertical MOS FET has emigrated to Japan after many years of neglect in its U.S. birthplace. Nippon Telegraph & Telephone Corp. is betting that fabricating transistors on the walls of trenches dug into wafers will yield the densities needed for multimegabit memory and other high-density chips, starting with 8- and 16-Mb mask-programmed read-only memory. The new FETs are also suitable for dynamic random-access memory and logic circuits.

The vertical configuration gives 1.5 to 2 times greater density than the conventional lateral geometry, according to Eisuke Arai, chief of the High Density Integration Section at NTT's Atsugi Electrical Communication Laboratories. The technique is one being explored to keep manageable the sizes of future-generation chips.

This is not the first time nonplanar FETs have been used in memory chips, however. In 1976, an AMI team led by T. J. Rodgers fabricated active devices in V-shaped grooves for memories. Difficulties with surface control and surface states forced the company to abandon its unconventional design. Though VMOS chips had smaller sizes and potentially lower cost, such pioneering designs were not needed at that time.

Today the number of bits per memory chip is growing faster than design rules are shrinking, which could lead to chips too large to fabricate with acceptable yield. In DRAMs, memory-cell capacitance cannot be cut without increasing soft errors that result from alpha-particle emissions. Hitachi, NTT, Toshiba, and others are actively exploring trench



ENTRENCHED. To boost chip densities, NTT researchers have built an active transistor on the side of an etched trench.

technology as a way to reduce area for a given capacitance in 4-Mb designs.

Production technology still has a way to go: NTT's Arai admits to having fabricated only discrete transistors so far. But he is confident that his group will be able to move rapidly toward 8- and 16-Mb mask-ROM densities.

When fabricated with 0.8-μm design

rules, the area of a mask-programmable 8-Mb ROM cell will be about 6.25 μm². The chip's area will be about 100 mm².

Arai's group then expects to fabricate other types of chips. Circuit design should be simpler than with VMOS because individual connections are available to the source, drain, and gate of all FETs. VMOS was limited because the sources of all the transistors were tied to the substrate.

Device fabrication starts with selective oxidation to define the transistor area. Then boron ions are implanted so that their region of maximum concentration forms the p+ channel at the midpoint of the depth of the 0.8-μm-deep trench in which FETs will be fabricated. Reactive ion etching is used to form the trench. Next, the 15-nm-thick gate oxide is formed in the trench, and polysilicon is deposited on the inner walls of the trench to form the gate. The thick region on top of the wafer is etched back, and the oxide film between the gate and the drain connection is formed.

After etchback of the oxide, the n+ polysilicon drain connection is formed and the moat is completely filled. Gate and drain contacts are metalized, followed by n+ diffusion of source and drain contacts. The n+ region that forms the actual drain contact to the drain connection at the bottom of the moat is implemented by solid-state diffusion from the n+ polysilicon.

The FETs have a nominal channel length of 0.8 μm; their actual length is the shorter region of the p+ implant layer. The chips show good electrical symmetry, so the drain and source can be interchanged—important in many circuits. Transconductance is about 50 millisiemens/mm of gate width and can probably be upped to about 120 mS/mm. Gate breakdown voltage is about 8 V—lower than for planar circuits, but it should be adequate for the 3-V power supplies that will probably be used for the post-VLSI generation of chips.

—Charles L. Cohen

GRAPHICS

INTEL, MATRA-HARRIS TEAM DEVELOPS GRAPHICS CHIP

NANTES, FRANCE

A Franco-American corporate pair is about to attack what they think will soon be one of the fastest growing sectors of the data-processing market: sophisticated graphics for personal computers and engineering work stations. The partners, Matra-Harris Semiconducteurs (MHS) and Intel Corp., have jointly developed an integrated circuit and an associated development tool to tap into

the demand for graphics applications and for windows to handle multitasking.

Their Video Storage and Display Device 82716 is the first design Cimatel—the design center the two companies own jointly—has completed. First silicon of the circuit was operational. MHS will market the circuit in Europe and Intel will market it in the U.S.

The one-chip graphics controller supports a 512-K-byte video random-access

memory and has a complete set of functions, including features unavailable in competitive products, claim its developers. The controller's architecture employs data objects that correspond directly with the windows, the user-defined rectangular areas of a screen.

That's a departure from defining and manipulating several bit planes. If a system's main microprocessor manipulates the bit planes, it cuts into system processing power. If a slave processor handles the task, hardware and software development costs mount.

With its data objects, the 82716 offers a single-chip solution to this problem. The chip uses hardware to implement up to 16 data objects, and MHS claims it is the only chip on the market to do so.

WINDOW DRESSING. Object information may be in one of three formats: bit-map, allowing normal graphics information to be displayed; simple character mode, for listings and dialogue; and attribute character mode, for videotex and higher-quality text displays. The position and contents of any object can be changed independently with respect to other objects, allowing dynamic movement and window creation and deletion.

Integrated on the chip are double line buffers for high throughput, a color palette from which users can choose 16 of 4,096 colors, a digital-to-analog converter for direct monitor connection, a fully programmable synchronizing generator that meets all the international videotex and graphics standards, and a simple microprocessor interface offering wire-

to-wire connection to any Intel 8- or 16-bit microprocessor.

The development tool that supports the chip consists of a single 8086-based pc board and a software module. It can be used with any IBM Corp. Personal

Computer or compatible.

The tool's simplified user interface, based on menus, enables users who have no knowledge of the chip's internal organization to develop graphics applications. —Robert T. Gallagher

COMPUTER-AIDED DESIGN

EC WORK STATION SPEWS OUT VLSI DESIGNS FASTER

ENSCHED, THE NETHERLANDS

Six European industrial and academic organizations have pooled their chip-design expertise to bring to market a work station for the development of very large-scale integrated circuits. Their work station—called Spirit, to convey the venture's collaborative ethos—is built around an open software architecture based on several standards, and was launched officially at the Fifth International Conference on Custom and Semicustom ICs in London this month. Most of the software described will be on sale by January.

The project was first funded under the European Communities' Microelectronics Program and is now being continued for three more years with funds from Esprit, the EC's fifth-generation computer effort. It is a predominantly Dutch project, with such participants as the Dutch technology universities of Delft, Twente, and Eindhoven, as well as the Institute for Computer Software

(ICS), the Enschede systems company that is leading the project. Also involved are British Telecom's Martlesham Research Center and PCS GmbH, a computer maker in Munich.

The collaborators have produced a range of chip-design tools, from a hardware-description language to a design-rule compiler, that can be used to fabricate chips in different silicon foundries. The software supports both gate-array and cell-based designs. Spirit represents a total of some 10 million lines of debugged code, says Peter van Es, who manages Integrated Circuit Design Ltd. (a subsidiary of ICS that specializes in software for computer-aided design) and heads the Spirit project.

A Spirit system can turn out chip designs in about one tenth the time of current systems, say its developers. It now generates IC designs at the rate of 70 transistors per day; by the end of 1986, that rate could double. Eventually, Spirit will evolve into a truly general-

ITC AGREES: JAPAN HAS HURT U. S. CHIP MAKERS

WASHINGTON

The first step toward resolving a dispute between U. S. and Japanese makers of erasable programmable read-only memories was taken Nov. 8 when the U. S. International Trade Commission announced a preliminary finding that Japanese imports have damaged U. S. companies. The ITC's unanimous vote means the Commerce Department will continue to investigate U. S. charges that Japanese companies are damaging U. S. manufacturers by dumping EPROMs on the U. S. market at prices below manufacturing costs.

The ITC ruling stems from a Sept. 30 petition by the three largest Silicon Valley chip makers—Advanced Micro Devices, Intel, and National Semiconductor—against eight Japanese companies that pro-

duce and export EPROMs [*Electronics*, Oct. 7, 1985, p. 14]. On Oct. 22, the Commerce Department's International Trade Administration opened an antidumping duty investigation covering processed wafers, dice, and assembled EPROMs produced in Japan and exported directly to the U. S.

If Commerce sides with the U. S. companies, the case would be returned to the ITC to determine whether dumping duties should be imposed. "If the commission is called upon to conduct a final investigation of this subject, we must attempt to build a fuller record on the [EPROM] production process," says ITC chairwoman Paula Stern. Such a record would include research, design, and wafer and die fabrication costs in the U. S., and final assembly operations

overseas, Stern adds.

The U. S. companies claimed damages of \$158 million for 256-K EPROMs and \$45 million for 128-K chips during 1985. Though the ITC agreed that U. S. companies have been damaged, it did not necessarily endorse those figures. It estimates that the Japanese now have about a 20% share of the U. S. EPROM market.

Japanese reaction to the ruling was muted. William Tanaka, a Washington attorney for the Electronic Industries Association of Japan, says only that the ruling is designed to give U. S. companies their day in court and is not necessarily a forerunner to finding substantial dumping margins.

If the ITC investigates U. S. EPROM production methods, it will find that Japanese companies are selling

below cost, predicts R. Michael Gadbaw, a Washington attorney for the Semiconductor Industry Association. Both Gadbaw and Intel attorney F. Thomas Dunlap Jr. called the preliminary decision the first step toward resolving the case.

The ITC move also distinguishes the EPROM case from other dumping cases, says Dunlap. The cost of, say, making steel doesn't vary monthly as do IC manufacturing costs. "It was important that they [the ITC] recognized that some of the things that apply to dumping steel won't apply here."

The Commerce Department will now send questionnaires to Japanese companies in order to investigate pricing and production costs. It must deliver a preliminary determination of dumping by March 10, 1986. —George Leopold

purpose silicon compiler, the necessary elements of which are already in place.

Among the tools are a floor planner, which acts as a gateway for design data and preserves design integrity; a mixed analog and digital simulator; and a parameterized-module generator that produces programmable logic arrays, bit-slice processors, and the like.

Underpinning Spirit's evolutionary potential is an open-ended software architecture that conforms to a number of standards the group set up to make it easier for the system to assimilate new tools. All software is developed to run under AT&T's Unix System V, and interfaces between software tools are based on standards so data can readily be transferred from one to another. Also, the user is presented with a common interface to all programs. The software adheres to industry standards such as GenRad Inc.'s Hilo for circuit simulation; EDIF, the Electronic Design Interchange Format for the description of IC data; and the Caltech Intermediate Format (CIF) and Calma's GDS II for the description of mask patterns.

A Spirit work station needs a minimum of 2 megabytes of main memory, 55 to 80 megabytes of disk storage, and a color-graphics display. ICD uses a Hewlett-Packard Co. HP-9000/500 or 9000/320, or VAX hardware from Digital Equipment Corp. The software also runs on computers from Gould SEL, Masscomp, and PCS, among others.

The several views of an IC design are marshalled through a hierarchical data base. As the gateway to all design levels, the floor planner controls the different design versions and is an integral part of the data-base manager, developed at Delft University. All additions and changes must be entered through the floor planner. Though sometimes tedious, it guarantees data integrity.

Spirit supports both top-down and bottom-up designs. The top-down approach

uses MoDL, a Lisp-based hardware-description language for constructing a formal description of hardware that can be proved correct mathematically, rather than by lengthy simulation. MoDL also provides a basis for incorporating expert systems into the design process. There is a schematic editor that converts net lists into an MoDL program.

The mixed-mode circuit simulator was developed by Eindhoven University of Technology. Its attraction is that it allows detailed simulation down to the analog performance of individual gates, without taking up too much computer time. Mixed-level modeling restricts the most detailed simulation to the subcircuits that require it, while other parts of

the circuit use coarser models.

Delft University of Technology developed the interactive placement-and-routing tool. The user can experiment with different system partitionings as well as change cell aspect ratios and pin locations. Once cells are in place, a global router assigns wires to channels.

British Telecom is rewriting its powerful symbolic design system, first written in Fortran under DEC's VMS operating system, to run under Unix. The work is to be described this week at the International Conference on Computer Aided Design in Santa Clara. But Spirit's developers believe that this overlap offers users the advantage of choice. —Kevin Smith

LOGIC DEVICES

NEW ARCHITECTURE BUILT IN PROGRAMMABLE LOGIC

SUNNYVALE, CALIF.

Major players in the programmable-logic marketplace have hinted for months at radically new architectures that will give their products greater density and flexibility. First out of the chute, however, is Signetics Corp., with the first in a family of bipolar parts.

The programmable-macro-logic (PML)

devices, as Signetics calls them, have densities of 3,000 to 3,600 two-input gates, even with a conservative 20% interconnection factor.

The technique, based on a matrix of NAND gates, is expected to yield chips of nearly 10,000 gates. At Wescon this week in San Francisco, Napoleon Cavlan, Signetics' product architecture manager and a pioneer in reprogrammable logic, described PML as a totally new architectural approach.

One chip, the PLH501, is primarily a "gate bucket" combinational-logic device including only primitive macro, or super-set, functions. It implements virtually all logic functions offered by existing combinational programmable logic arrays, says Cavlan. He claims it is also the first such programmable part to provide true exclusive-OR output functions as well as multilevel gate constructs and cross-coupled latches on-chip without involving output pins. Built with Signetics' ZA-2 oxide-isolation process, it has a NAND matrix equivalent in size to a 16-K PROM and input-to-output delays of no more than 17 to 25 ns.

The PLH502 is a sequential device including higher-level functions in the form of clocked shift registers and D-type flip-flops, split into two banks of eight to adapt it more evenly to control

and data-path manipulations. Built with Signetics' advanced HS-III oxide-isolation process, its NAND matrix is about 30% larger than the 501's and it features delays from 12 to 16 ns.

Most current programmable logic devices rely heavily on a fixed AND-OR gate chain linking primitive I/O and logic functions on-chip. Signetics replaces

such structures with logically equivalent NAND-NAND gates. These express combinational logic functions as the sum of logical products and

provide a central, programmable interconnection for a variety of multilevel macro functions on the chip's periphery.

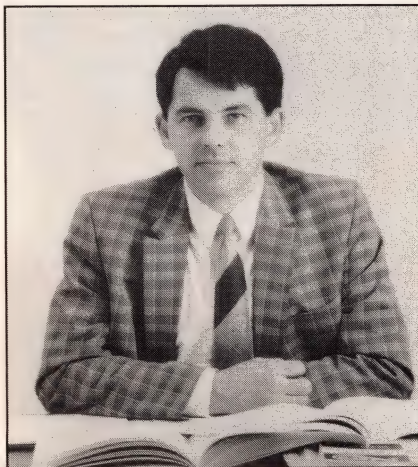
Cavlan says the architecture exploits the fact that programmable NAND-NAND logic chains can be created by coupling identical NAND gates with programmable inputs, allowing an entire array string to be implemented as a single global array with feedback. When the feedback path is a simple wire, the array can be split into single- or double-level true-complement logic functions by programming single or double interconnecting paths through the array.

But the true power of this approach, says Cavlan, lies in its ability to implement more complex functions by programming multilevel logic loops through the array or by introducing into the feedback loops a variety of higher-level macros. In addition to flip-flops, buffers, counters, shift registers, multiplexers, and decoders, PML includes such high-level functions as arithmetic-logic units and memory blocks.

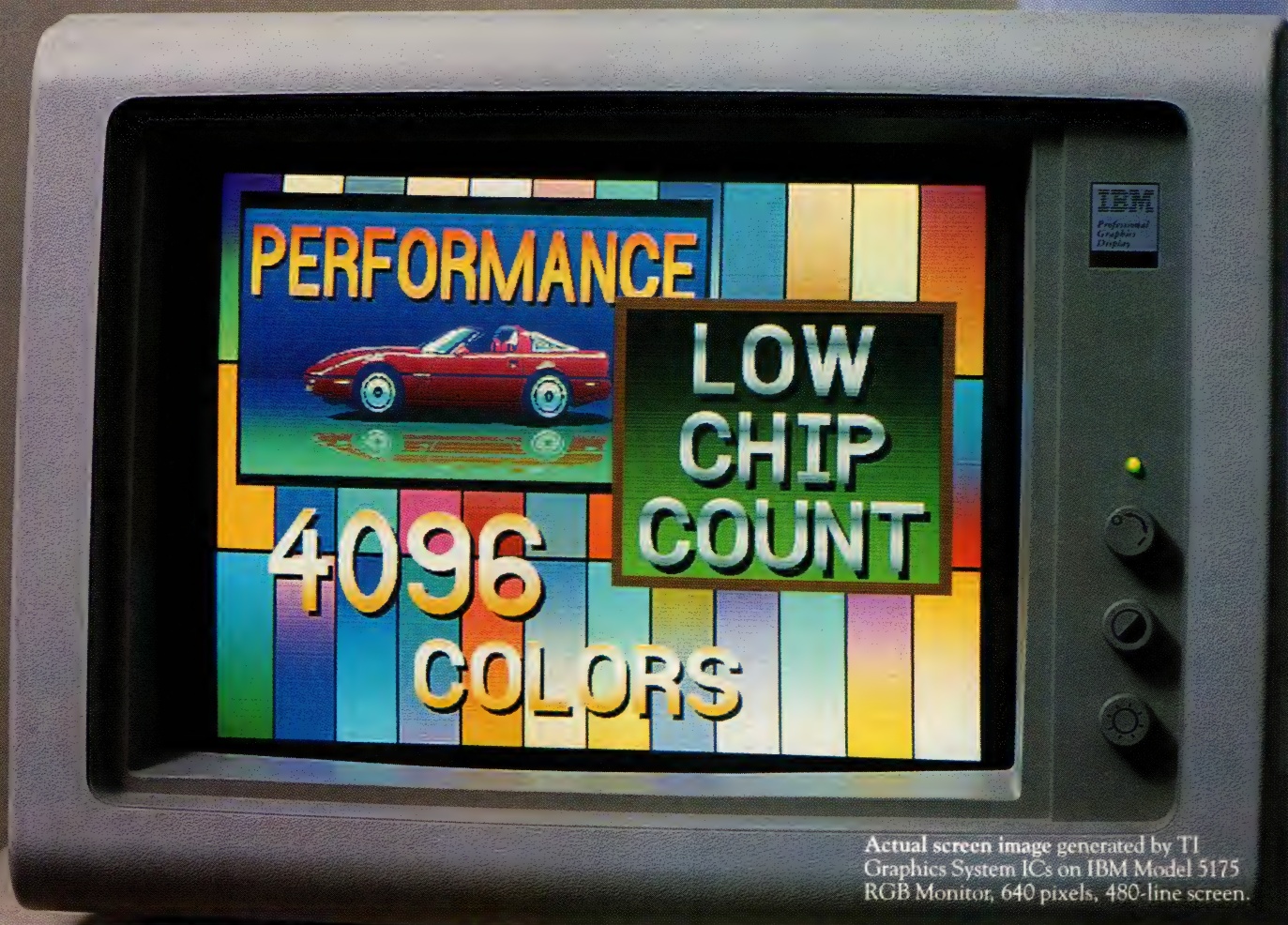
The architecture's main advantage for programming, says Cavlan, is that it re-

The NAND matrix promises chips of 10,000 gates

SPEEDY. ICD's van Es says Spirit offers 10 million lines of debugged IC-CAD software.



Take the "wait" out of graphics. TI's new ready now!



Actual screen image generated by TI Graphics System ICs on IBM Model 5175 RGB Monitor, 640 pixels, 480-line screen.

Personal computers, bit-mapped terminals and work stations — design in the new graphics-system ICs from Texas Instruments and you move them to market faster. Because TI's new system concept is much simpler than anything before. And because it is available now in ICs, design kit, or evaluation board.

Fewer system components, greater system flexibility

You are working with only a fraction of

the parts normally required to build a bit-mapped graphics system:

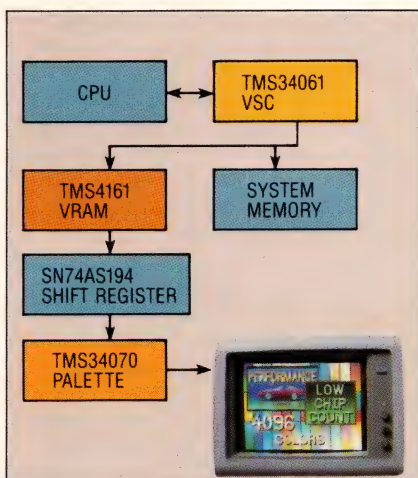
- TI's new **TMS34061 video system controller (VSC)** for video RAMs eliminates separate text and graphics subsystems.
- TI's new, **low-cost video palette** contains all circuitry normally difficult and expensive to build with discrete components.
- TI's **innovative multiport video RAM (VRAM)** provides virtually

unlimited memory bandwidth and ends contention problems between display refresh and update.

TI's is a system that gives you a wide degree of flexibility. It supports screen resolutions from 256×256 to 4096×4096 pixels ... any number of colors ... and works with any 8-, 16-, or 32-bit CPU.

And it is only the beginning of a growing family of graphics products from TI, the pioneer in video-graphics ICs.

of your bit-map system ICs are



A minimum number of components make up TI's new graphics system. Its simplicity cuts costs, speeds implementation. These components are designed to operate effectively as a system but can be used independently.

Three-in-one high-performance controller

An industry first, TI's new TMS34061 VSC combines the control of VRAMs, DRAMs, and the CRT in one device. It is designed for use with TI's TMS4161 64K VRAMs and future 256K VRAMs, as well as 64K and 256K DRAMs.

Its open architecture permits use with any processor up to 10 MHz and with any data-bus width.

The new VSC allows your host processor direct access to the bit map on more than 95% of the memory cycles, because it refreshes the screen while simultaneously updating video memory. And, the new TI VSC chip cuts chip counts of typical systems by as much as 70%.

The TMS34061 VSC comes in a 68-lead plastic chip carrier (PLCC) for surface mounting. It can also be mounted in readily available sockets.

Space-saving video palette expands color choices

You can enhance color-display capabilities with TI's new 4-bit color palette, TMS34070. It provides 4096 colors per

screen; each line can contain any selection of 16 colors from the 4096.

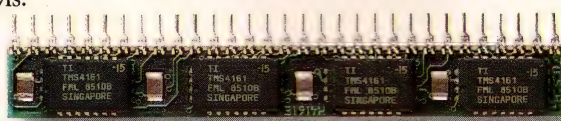
In a single package, the palette combines a color-look-up table with video-speed digital-to-analog converters. These directly drive the red, green, and blue signals — a more economical solution compared to conventional hybrids.

The new TMS34070 palette allows the look-up table to be changed line by line for more realistic pictures. A color-repeat capability permits realtime animation, and the palette loads itself directly from memory without processor intervention.

Multiport video RAM offers serial-in capability

The unique multiport design developed by TI for its TMS4161 VRAM has won widespread use in graphics systems. Separate serial and random-access ports allow you to shift data into or out of memory while simultaneously accessing the memory. Display refresh consumes less than 5% of available memory access, effectively eliminating contention problems.

In addition, serial input capability allows rapid bulk clear, image capture, and cascading of on-chip shift registers.



Much greater memory densities and improved reliability are achieved by using fully qualified, production-proven video RAMs configured in single-in-line-package (SIP) modules. TI SIPs combine the density of surface-mount technology with economies of through-hole insertion.

The TMS4161 is available in dual-in-line packages, plastic leaded chip carriers, and single-in-line-package (SIP) memory modules with either 64K × 4 or 64K × 5 configurations.

The SIP modules consist of multiple TMS4161 VRAMs surface-mounted on a substrate for through-hole board insertion. Leaded and socketable versions are available. TI SIPs can achieve as much as a 3.5 × increase in board den-

sity over DIPs, thereby reducing board size or increasing system functionality.

New kit provides "hands-on" design experience

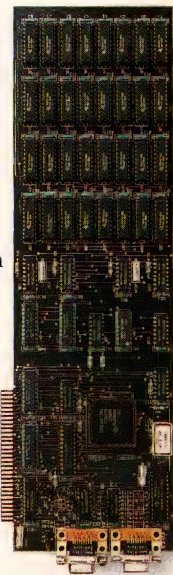
Now available from authorized TI distributors is TI's new Graphics Design Kit, TMS340GDK. It contains what you need to familiarize yourself with TI's new graphics-system ICs.

Included are a TMS34061 VSC, two 64K × 4 video RAM leaded SIPs, a TMS34070 video palette, a 68-lead PLCC socket, user's guides, data sheets, and other supporting documentation. The kit price is \$99.00 (U.S.A.).

Evaluation board allows immediate systems test

The best way — the fastest way — for OEMs to evaluate the resolution and quality of the TI graphics-system ICs is to plug in the new TMS340 Color Graphics Controller Board. Available from your TI distributor, it works with IBM-compatible PCs. For \$995.00 (U.S.A.), you get a complete board — populated with VSC, video palette, and VRAMs — plus a floppy diskette with demonstration software and a user's guide. Ask for TMDS3471804000.

Why wait for better graphics? TI's new TMS340 family graphics-system ICs are ready now. Call your authorized TI distributor, or for more details, call 1-800-232-3200, ext. 3501. Or contact your TI Field Sales Office or Regional Technology Center.



TEXAS INSTRUMENTS

Creating useful products and services for you.

lies on a single array to interconnect all macros. This "reduces the design task to building what is essentially a PROM-like structure, more forgiving than the double array in PLA-type devices and more flexible than [PAL]-like devices."

In terms of density, the ability to forge the NAND-gate core into multilevel logic paths at will significantly increases the gate-utilization efficiency compared with traditional AND-OR implementations. —Bernard C. Cole

MEDICAL

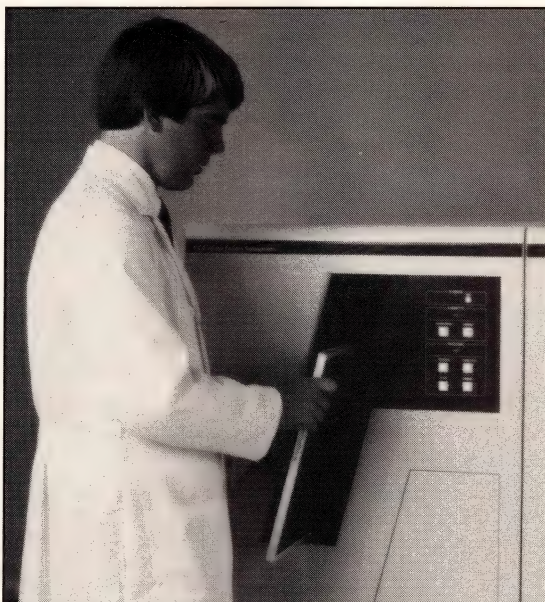
DIGITIZING X RAYS TO ENHANCE, STORE EASIER

CHICAGO

Digitization of X-ray images, an ongoing topic of much discussion and research, is finally happening with a new product from Philips Medical Systems Inc. The Shelton, Conn., branch of North American Philips Co. is using the annual Radiological Society of North America meeting this week to introduce Philips Computerized Radiography (PCR), a system to digitize and store medical X-ray images for electronic viewing and transfer to film.

Electronic imaging permits easier storage of X-ray images, computer-aided enhancements to the X rays, and safer examination of patients. Also, electronically stored images can be easily compared with one another on a high-resolution cathode-ray tube for before-and-after evaluations of a patient's progress.

The Philips system provides the same amount of information in an electronic image, as does film, which is used in 80% of the imaging handled by diagnostic radiologists, says Frank Low, senior vice president of Philips Medical Systems. The remaining 20% consists of modalities that are already digitized, such as nuclear-magnetic resonance, digital subtraction



LOW-DOSE. A reusable imaging cassette is inserted into the PCR. Greater sensitivity permits softer X rays.

angiography, and ultrasound.

"Patients will benefit in two ways," says Low, "first, because computer enhancements can show features that might be missed in conventional X-ray film, but more importantly, because the patient is spared the additional radiation that would be necessary to reimage a missed feature."

Another advantage of PCR is its ability to produce diagnostically useful im-

ages over a range of X-ray exposures: from 1/10 to 10 times the usual dose. "Most often, however, the sensitivity of PCR permits imaging at a much lesser roentgen level than film X rays require, which can be vital when multiple exposures of children are taken," Low says.

The initial imaging sensitivity derives from a reusable image plate with a photostimulable phosphor coating. The plate is placed inside a standard X-ray cassette in lieu of X-ray film and intensifying screens. The image is exposed as in conventional film systems, but instead of its being processed by photographic development, a laser scans the stimulated phosphors to extract and digitize the image. A Philips-engineered image-processing unit manipulates the digitized data, based on such preprogrammed parameters as contrast and spatial frequency, to optimize an image for what a radiologist wants to view. The manipulated image can be printed on film or stored on optical disk in a complementary picture-archiving and communications system, also from Philips.

PILOT TEST. For the past three years, the Medical Systems Division of NV Philips, the Netherlands, and Philips Medical Systems Inc. have cooperated with Fuji Photo Film Co., Tokyo, in the evaluation of a computer radiographic imaging system built by Fuji to Philips' specifications. After a 16-month pilot test of the PCR prototype at the Ochsner Clinic in New Orleans, the head of Ochsner's diagnostic radiology department, Christopher Merritt, reported it "to be the preferred method for a number of modalities, including tomography and portable studies."

Other prototypes have been installed at the UCLA Medical Center, Los Angeles, and at Rush-Presbyterian-St. Luke's Medical Center in Chicago. Low expects PCR production units to be available in spring 1986, with the Ochsner Clinic and New York University Medical Center first in line to receive them—for about \$500,000 each. —David M. Weber

COMPANY STRATEGIES

CONVERGENT'S TRICKY NEW STRATEGY

SAN JOSE, CALIF.

Convergent Technologies Inc. is embarking on a tricky new strategy for survival that for the first time will take it beyond its traditional role as a provider of computer systems for original-equipment manufacturers. Convinced that growth in this business will eventually slow to a standstill, the San Jose company plans to form a "federation" of top-notch companies serving vertical markets.

Convergent will own all or part of the

companies and aims to provide the computers that will be the base from which these companies will develop systems serving niche applications. The trick for Convergent will be to find niche companies that won't compete with its OEM customers.

The first company in the federation is Baron Data Systems of San Leandro, Calif., which earned \$17.9 million in revenues for fiscal 1985 selling integrated systems for court-reporter, medical-records, and legal-support markets. Con-

vergent just bought 40% of the company for about \$14.6 million.

Convergent is entering a booming field, says Gwen Peterson, director of the Business Computer Systems Industry Service for Dataquest Inc., a San Jose market research company. She estimates that some 4,000 value-added resellers already exist for vertical market applications. Though many of the companies are tiny, she believes it is "very clear that people who are going to succeed...are those who do a good job

addressing specific needs."

Peterson mixes her approval of Convergent's federation plan with a warning. "I think it's a wonderful idea," she says. "But they [Convergent] will have to watch out for the fact that their customers are also participating in specific vertical markets, and they might wind up inadvertently competing after all. It's certainly hard to avoid."

However, Convergent president and chief executive officer Paul C. Ely Jr. isn't worried. "Convergent is the only company I know that is only in the OEM market," he says. "All our competitors are in both businesses, but often compete with their OEM customers." Ely believes the new strategy won't tread on the toes of Convergent's OEM customers, but will build a demand for its products in ever-growing specialty markets.

Ely's criteria for choosing Baron Data included its knowledge of vertical markets, its use of Convergent products, and his belief that projects under development will yield further growth. Other candidates, Ely says, would have to be tops in their niches with \$10 to \$100 million in annual revenue and be in small markets that aren't of primary interest to the company's OEM customers.

Convergent is already earning a good living as an OEM provider of work stations, supermicrocomputers, and superminicomputers. Despite the industry slump, revenue in the first nine months of 1985 was \$295.3 million, an increase

of 19.9% from \$246.3 million for the same period in 1984. A major customer is AT&T Information Systems, for which it builds the Unix PC. At a recent financial analysts' meeting, Ely also claimed the company met its goal of signing another major OEM contract, but wouldn't divulge the company or the product.

However, Ely expects the OEM business to begin slowing three to five years from now when the company reaches the \$1 billion mark. By then, he wants a federation of companies in



place to take up the slack.

"If we wait until the growth slows, such strategies won't be as easy to implement," says Ely. "We're hoping for \$200 million to \$300 million incremental growth for the next three to five years."

Convergent's first step is certainly no threat to its OEM customers. "We're shipping almost 100% Convergent equipment right now," says Baron Data's president, Garrett Fitzgibbons. "The exception is a package that runs on [IBM Corp.] PCs, but that's a small number."

Fitzgibbons says there is nothing in the agreement that mandates Baron Data must use only Convergent products. Instead, he says, Convergent is counting on Baron Data's strengths in developing its vertical market strategy.

"Of course they'd much prefer we use their machines. But the intent here is to look at us as the front man, so to speak," says Fitzgibbons. "So we will go out, with Convergent's help, to find other vertical applications to bring into the fold."

"It's like the department stores, where they maintain their own names and individuality and the large company becomes the holding company. We're envisioning setting up that type of arrangement, though we haven't gotten that far yet."

—Denise Caruso

BRANCHING OUT. Convergent president Paul Ely is after specialty markets.

CONSUMER

A NEW TRY TO RAISE TV AND VCR PRICES

GLENVIEW, ILL.

Like kids throwing mudballs against a brick wall, consumer video manufacturers are hoping that their plans to raise prices of color TVs and video cassette recorders next year will stick.

Sony Corp. of America and Zenith Electronics Corp. launched the first trial projectiles Nov. 5. In Park Ridge, N.J., the U.S. operation of Tokyo-based Sony said it will hike prices by 5% to 12% across its electronics product line next year. And Zenith, in Glenview, Ill., said it "plans to announce selective color television price increases," in addition to general VCR price hikes, at its distributor meeting this Wednesday.

With the exception of South Korean manufacturers, most other video makers have since fallen pretty much in line. "We definitely feel we're going to support the price move. This annual 6% to 7% deterioration in TV prices can't continue," says a spokesman at N.A.P. Consumer Electronics Corp., Knoxville, Tenn. Industrywide price increases next year "are an inevitable situation, as far

as we can determine," adds a U.S. official for Japan's Matsushita Electric Industrial Co.

Sony and other Japanese manufacturers cite a need to offset the falling value of the U.S. dollar against the Japanese yen as the primary drive for an upward price move. Korean currency,

*For five years, prices
have done nothing
but slide downward*

on the other hand, is basically linked to the dollar, so Korean manufacturers such as Gold Star and Samsung Electronics are not significantly affected by the dollar's decline against the yen.

Domestic TV makers such as Zenith—which lost \$14.8 million in the third quarter—see price hikes as a badly needed salve for bleeding bottom lines. Though no company manufactures VCRs in this country, RCA, N.A.P., and General Electric all make TVs here, in

addition to Zenith, and they all complain that severe pricing pressure driven lately by South Korean manufacturers is taking a heavy toll.

RCA Corp. is believed to be maintaining profitability in its video operations thanks in large part to royalties received on basic patents. But N.A.P. and General Electric Co., like Zenith, say they are losing money on color TVs. GE, in fact, recently gave up on domestic manufacturing, announcing last month that, next August, it will stop making 19-in.-diagonal and larger TV sets at its Portsmouth, Va., factory, choosing instead to get its TVs from Matsushita.

DOWN. If U.S. TV pricing does increase next year, it will reverse a five-year trend in which pricing has done nothing but slither downward, pushed by fierce pricing pressure in an industry that counts about 30 different brand names. VCR pricing, meanwhile, has been plummeting, with some industry observers pegging the drop at about 30% so far in 1985 on a year-to-year basis.

Despite the current bold talk about

The evidence is in, and it's incontrovertible. When it comes to light, Anritsu runs second to the sun.

True, Anritsu's little laser diodes *are* powerful enough to raise more than a few eyebrows.

And Anritsu optical attenuators can cut *almost* any light source down to size.

And Anritsu optical power meters can take anything a *normal* fiber optic system can dish out.

But none of them can hold a candle to the sun, with its 900×10^{23} -or-so calories every second and 10-billion-year MTBF.

Still, if you take a closer look, you'll see a bright side to this story.

For instance, let's talk technology: does the sun have anything like Anritsu's laser-accurate outside diameter measuring system for optical fiber production?

In sophistication, Anritsu also has a clear edge. With optical time domain reflectometers and optical spectrum analyzers that give a clear, accurate picture of an entire fiber optics network.

And in terms of visibility, the Anritsu name has become almost an industry standard. Thanks to a dazzling range of measuring

Why We're Only #2 In



instruments and light sources for all facets of fiber optic communications. What about versatility? Simply no competition: Anritsu has more than 11,000 products and systems, and these extend to areas far beyond light. To rugged radio and telecommunications equipment. To public telephones, computers and data processing equipment. To measuring instruments for communications. The list goes on and on.

The sun is still safely #1 for now. But we're on the move.

Circle 33 on reader service card

Anritsu
WE'RE ON THE MOVE. WORLDWIDE.

ANRITSU CORPORATION

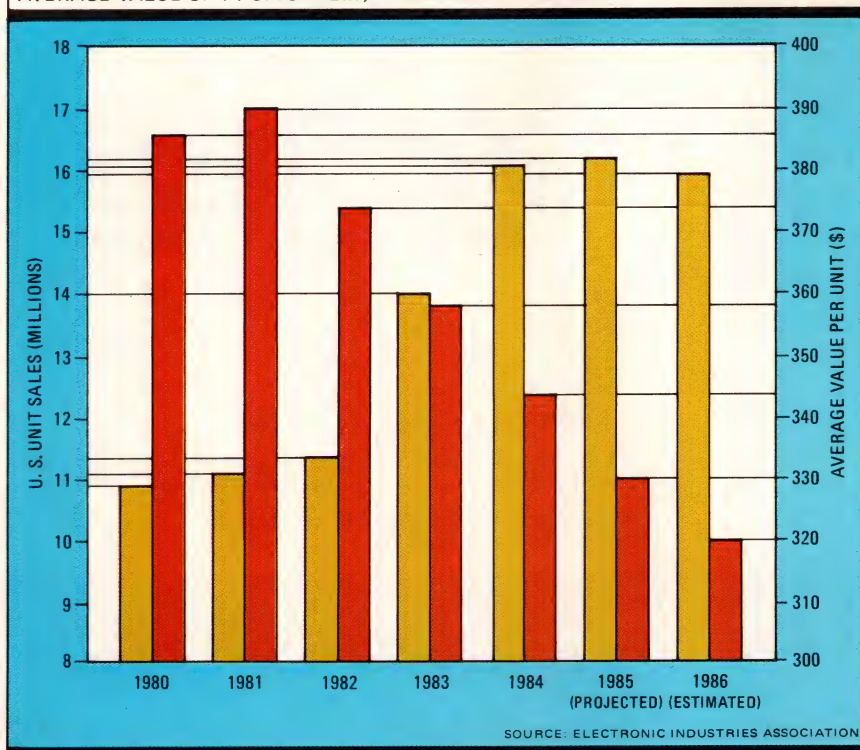
10-27, Minamiazabu 5-chome, Minato-ku, Tokyo 106, Japan.
Phone: Tokyo 03-446-1111, Telex: 0-242-2353 ANRITU J

*As of October 1, 1985, Anritsu Electric Co., Ltd.
became Anritsu Corporation.*

The World of Light



AVERAGE VALUE OF TV SETS FALLS, AND SALES HIT PLATEAU



price increases, most industry observers say that manufacturers will be doing well next year if they manage to hold the line or even slow down the pricing slide, given competitive pressures. Compared with this year's 7% TV price decline to date, even that would be constructive, says Charles Ryan, a vice president at New York investment house Merrill Lynch & Co. "Prices in recent years have been deteriorating at a faster rate than the industry can improve its productivity," Ryan observes. He projects TV pricing next year will decline about 2%.

"It makes sense that an increase is necessary. But one of the big problems

is the Koreans," says David Lachenbruch, editorial director for *Television Digest*, an industry trade publication.

Even though Korean manufacturers have been paying 7% to 15% TV dumping penalties imposed by the Commerce Department since last December—the result of an earlier action filed by U.S. manufacturers and others—the Koreans have continued to lead pricing downward, particularly on 13-in.-diagonal TVs. Zenith, for one, has complained loudly that Koreans have been circumventing the dumping penalties (assessed on assembled sets) by stepping up imports of color TV kits, which are put together in assembly plants here.—Wesley R. Iversen

IC PRODUCTION

SILICONIX JOINS CLASS 1 CLEAN-ROOM ELITE

SANTA CLARA, CALIF.

A power-transistor maker has become one of the first semiconductor houses to put its main manufacturing environment into a Class 1 clean room. Siliconix Inc. is keeping pace with the most advanced integrated-circuit makers by putting its new 6-in.-wafer fabrication line for smart-power MOS FETs in a Class 1 room. That rating indicates fewer than one particle of dust larger than 0.2 μm in diameter per cubic foot of air.

Class 1 clean rooms are a thousand times cleaner than the now-standard Class 100 rooms, but they are necessary

for building submicron circuits. Yield-modeling algorithms predict that yields would sink to zero for finer geometries at Class 100 defect densities.

"Class 1 clean rooms have just come into being in the past couple of years," says G. Dan Hutcheson, a semiconductor-production analyst with VLSI Research Inc., San Jose, Calif. "It's the fastest-growing segment... of clean-room area; in 1983 there were only 17,000 ft^2 of it, and last year there were 211,000 ft^2 . This year it will be at least 300,000."

Submicron chip technology is usually thought of as a vehicle for high-density

ICs, but discrete power transistors are also on this leading edge. They derive power from the meshing of many very fine lines. Siliconix uses 5- μm technology for its smart-power devices. Its new facility will enable it to meet required production tolerances well into the 1990s. "To go to finer lines, we will just have to change our steppers," says chief operating officer Douglas Sullivan.

In the meantime, Siliconix is getting big increases in yield over its 4-in. line, Sullivan says. He declines to quantify the increase, but says it is significantly above what he had expected.

The new plant has five diffusion tunnels, one of which is now operating. Each tunnel will contain eight 6-in. tubes, which are fed by a robot loading station in a Class 1 area.

Class 1 cleanliness is measured only for the area immediately around bare wafers, explains James Burnett, executive director of the Institute for Microcontamination Control in Santa Clara and the designer of the Siliconix facility. Aisles outside the fab area are measured at Class 10.

The institute measured each Class 1 area with 10 particle counters along the walls at 10-ft intervals. An aisle was rated Class 1 if no station counted more than two particles and its total was no greater than 13. Actual cumulative particle count for three aisles measured has been 2, 1, and 0, Burnett reports.

The key to obtaining the Class 1 measurement, he says, is the room's aerodynamic design. There are no horizontal surfaces for dust to sit on and walls are detailed carefully for smooth air movement in the bare-wafer area.

U.S. AHEAD. The Microcontamination Institute has helped install more than 20 Class 1 facilities for companies in the U.S. and Europe. Among them are Integrated Device Technology, Zilog, and Bipolar Integrated Technology, a Beaverton, Ore., startup. Burnett says he believes U.S. technology is ahead of Japan's in this area.

When fully utilized, the Siliconix plant will have a capacity of 15,000 wafers a month, says Sullivan. The total fab area, unequipped, cost about \$14 million; by the time the facility is complete, it could cost \$40 million. "That's not a lot of money for a fab," he says. "We want to make ¼-in. dice cheaper than the competition. We can then be supercompetitive and gain a share of market, or just compete and make more money."

"But the real way we will make our mark is to go to very large chips. We feel that with what we have seen in the early runs, we can make chips as big as will fit into packages."

The company also plans gate arrays and CMOS linear chips with very fine lines.

—Clifford Barney

**FEW REMEMBER
WHO WAS SECOND
ON THE MOON...**



**OR SECOND
IN THE MARKET...**

AT&T DOESN'T THE MOON...JUST AT BEING FIRST

Introducing the

The fastest shot.

How can AT&T make that kind of promise? Because AT&T offers you the first full 32-bit chip set with the performance you need.

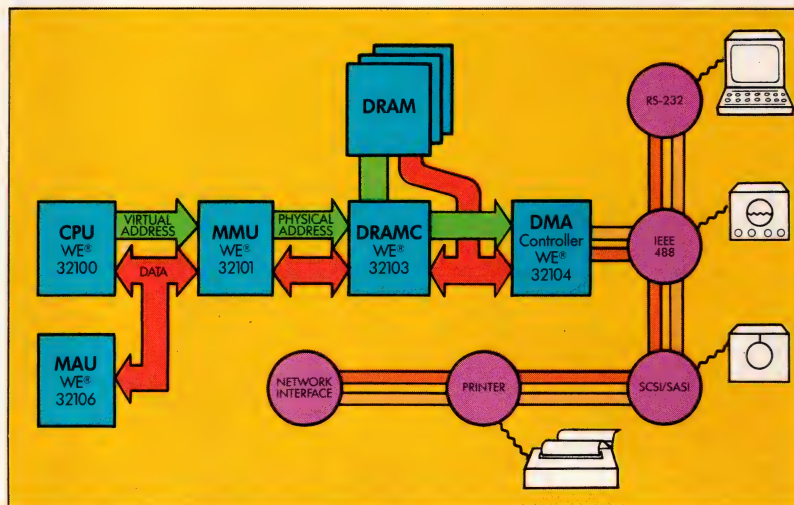
A system that can actually cut your design time in half—with chips, not smoke.

World's most complete 32-bit chip set.

Check the schematic: AT&T is on board and ready to deliver the peripherals you need to meet your market window. It's the only chip set with CMOS every step of the way—and full TTL-compatibility.

The WE® 32100 Microprocessor is the heart of it. A second-generation CPU backed by five years of AT&T experience delivering 32-bit microprocessors. And by extensive experience in application of those processors to systems. Its high-speed instruction cache can store 64 32-bit words.

The Memory Management Unit (MMU) is



100% complete, 100% TTL-compatible, 100% CMOS
AT&T Bell Laboratories doesn't do things half way.

also a second-generation component. It has 4 gigabytes of physical and virtual address space; lets you design on a paged and/or segmented basis; and includes on-chip miss processing.

The Math Acceleration Unit (MAU) conducts single, double, and 80-bit floating point arithmetic at rates exceeding one million Whetstone instructions per second. It can, for example, add or subtract in 1.4 microseconds. The MAU also performs 18-digit BCD arithmetic. And it meets full IEEE standards.

The Direct Memory Access Controller (DMAC), a full 32-bit peripheral, delivers the

highest-speed transfers in the industry—including memory-to-memory and memory to-and-from a separate 8-bit peripheral bus.

The Dynamic RAM Controller (DRAMC) can be programmed to optimize your memory speed to the system.

With AT&T's total architecture, you won't waste time on glue logic, your device count will be lowered, your hardware design simplified.

And our system-wide CMOS means reduced power, less heat, greater device density, and fewer headaches. Absolutely nothing to slow your move from concept to product.

Optimized for UNIX System V, from the people who invented it.

One of the most important things AT&T gives you is a hardware assist for the world's most productive operating system: UNIX System V.



PROMISE YOU THE FASTEST SHOT IN THE MARKET.

AT&T 32-Bit UNIX™ Microsystem.

Our system architecture is designed to mirror in hardware the model of UNIX System V process.

We've developed today's most highly-optimized C language compiler, ensuring compact, high-performance code without manual optimization. Also available; compilers for high-level languages such as Fortran, Cobol, Pascal and Basic. To keep you on the leading edge, the AT&T microsystem will continue to evolve with the UNIX System V standard.

Performance that has 'first-in-the-market' written all over it.

AT&T's 32-bit CPU is a high-performance microprocessor that gives you 2 to 3 MIPS at 18 MHz. And at an unprecedented 18 MHz, you get up to four times the power of an equivalent VAX.*

Our floating point operation speeds you along with a capability exceeding one million floating point instructions per second.

Our Memory Management Unit means you won't be burdened with address processing or referenced-bit and modified-bit updating—this and other routine memory management functions are all handled by the chip.

Our Direct Memory Access Controller enables you to perform a memory-fill operation at a sizzling 9 megabytes-per-second.

Our Dynamic RAM Controller gives you two unique, performance-enhancing capabilities. It's the only RAMC that supports double-word

and quad-word memory fetches; the only one that can interface with a one-megabit DRAM.

Add to all of that an AT&T Evaluation Board that's today's fastest way to benchmark against all other microprocessors. It features zero wait state memory, resident assembly-level debugger, and CPU and Memory Management Unit with Math Acceleration Unit option.

Maybe somebody else gives you some of these features, but nobody else is ready to give you all of them. Now.

And nobody else matches AT&T's ongoing commitment to evolve and enhance system performance gracefully and compatibly.

Our Development System puts time on your side.

AT&T's Development System incorporates in-circuit emulation of the CPU and Memory Management Unit. And because it performs high-level language debugging, you'll know how your program will work before you commit to production.

Our Software Generation Programs operate with a UNIX System V host—a high-level language program development environment. It provides compilers no other system can match.

Across-the-board design and development support.

'Support' doesn't really cover it. At AT&T, we think of it more as a partnership. With Field Application Engineers who will work with you when and where you need it—from concept to product. With complete data sheets,

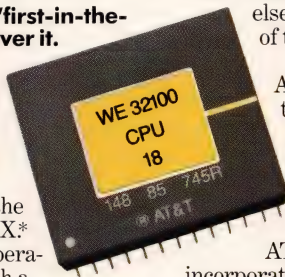
manuals and application notes. With training sessions and seminars to get you up to speed on the how-to's of 32-bit development.

Make your move now to the new AT&T 32-Bit UNIX Microsystem. We can't guarantee you'll be first in the market. But we'll give you the fastest shot at it.



AT&T

The right choice.



Please rush me your Executive Briefing on the new AT&T 32-Bit UNIX™ Microsystem.

EL 11/18/85

Write: Joe McQuarrie, Sales Vice President,
AT&T, 555 Union Blvd.,
Allentown, PA 18103

And don't forget technical brochures for my design people.

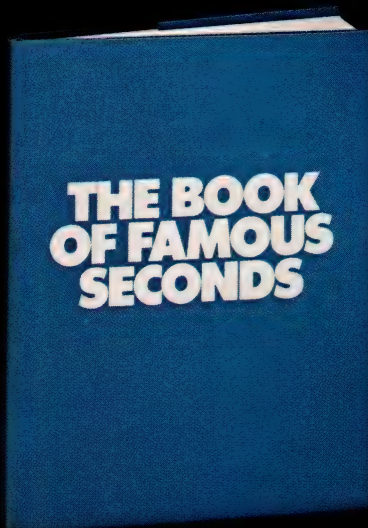
Name _____	Designer _____
Title _____	Title _____
Company _____	Designer _____
Address _____	Title _____
City _____ State _____	Designer _____
Zip _____ Phone () _____	Title _____

Or call 1 800 372-2447 for fast action. Telex: 9109973611.

*VAX is a trademark of the Digital Equipment Corporation.

© 1985 AT&T Technologies, Inc.

PLAY AT&T'S "FEW REMEMBER WHO WAS SECOND" GAME



Remember James Mollison?

Very few do.

He was the second man to fly solo across the Atlantic—at the time, a remarkable feat.

But Lindy did it first.

So try your hand at picking those unheralded heroes who missed out on fame by coming in second. Just three out of six will do it. That should be a piece of cake for you trivia fans.

Make your choices and mail the coupon. The first 500 entries we receive will each be awarded a prize.

The prize? Of course—The Book of Famous Seconds. It's quite a conversation piece—and interesting to anyone planning to develop a 32-bit application.

WHICH ONES WERE SECOND?

If you get at least three correct answers, and your entry is among the first 500 received, you'll win The Book of Famous Seconds.

And to be sure somebody else is second in the market with your 32-bit application, fill in the other side of this coupon and mail to the address shown.

- | | | |
|---------------------------------|--|--|
| 2nd to run a 4-minute mile | ☐ Roger Bannister | ☐ John Landy |
| 2nd to perform heart transplant | ☐ Adrian Kantrowitz | ☐ Christian Barnard |
| 2nd man to solo the Atlantic | ☐ James Mollison | ☐ Charles Lindbergh |
| 2nd to reach the South Pole | ☐ Roald Amundsen | ☐ Robert Scott |
| 2nd to swim the English Channel | ☐ Gertrude Ederle | ☐ Mercedes Gleitz |
| 2nd to break the sound barrier | ☐ James Fitzgerald | ☐ Charles Yeager |

© 1985 AT&T Technologies, Inc.



AT&T

The right choice.

INSIDE TECHNOLOGY

OPTICAL ICs: THE NEW ALTERNATIVE

A SPURT IN DEVELOPMENTS SPEEDS MOVE TO MARKET

by Bernard Conrad Cole

While silicon-based bipolar and CMOS technologies battle it out with gallium arsenide for domination of the high-performance end of the integrated-circuit market, a new contender is moving in slowly and quietly to stake its claim: integrated optical circuits based on gallium aluminum arsenide and indium phosphide. Research in the U.S., Japan, and Great Britain has been steadily solving many of the problems associated with optical-circuit technology, sometimes with surprising results. Consequently, the promise of integrated optics—in which light waves are guided, switched, modulated, and detected on monolithic equivalents of electronic circuits—is on the verge of being realized.

Two major problems still face the technology: transferring a significant amount of the research and development work into a manufacturable technology, and limits on the level of integration. But several converging developments are improving its position as an alternative or aid to integrated electronics in such high-performance niche applications as fiber-optic communications, military communications, signal processing, and supercomputers.

First, laboratory demonstrations of optical-circuit integration on a single chip with a density roughly equal to small-scale integration have resulted in a variety of working digital and linear optical circuits. Second, a number of supercomputer projects have emerged based on various proposed integrated-optics concepts [*Electronics*, June 10, 1985, p. 24].

There is also an existing base of users in the commercial world who are familiar with building systems involving the manipulation of light waves. Based on fiber optics as well as on discrete and hybrid switching and modulating elements, these systems can easily incorporate higher-integration solutions as they become available. And there is the increasing interest of the military in the concept—some of the most successful integrated-optics projects have involved military applications.

Finally, and most critically, many of the basic fabrication and production tools necessary—such as molecular-beam epitaxy and sophisticated ion-implantation procedures—are becoming available. They are already under development for use in the fabrication of nonoptic GaAs circuits and in very large-scale-integration silicon-based circuits.

The bulk of the R&D to date has focused on three main areas:

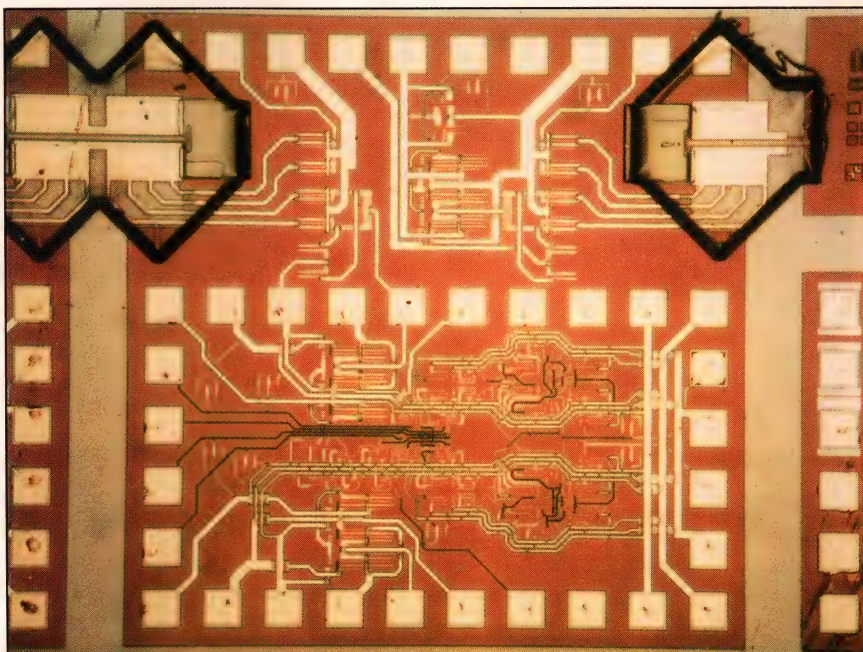
- Integrating optical components—sources, guided-wave interconnections,

modulators, filters, refractors (lenses), beam splitters, reflectors (mirrors), switches, and detectors—and fabricating them in planar fashion onto a variety of monolithic substrates.

- Constructing optoelectronic components that combine electronic and optical logic elements onto the same monolithic substrate.

- Fabricating vertical superlattice structures using optically bistable devices based on the Fabry-Perot effect and the multiple-quantum-well (MQW) phenomenon.

In Japan, the list of major participants in integrated optic and optoelectronics R&D reads like a who's who of IC manufacturers: Fujitsu, Hitachi, Mitsubishi, NEC, Sony, Toshiba, among others. In the U.S., however, most of the major semiconductor companies are noticeably absent from the list. But any slack is being made up by the contributions from AT&T Bell Laboratories, Battelle Memorial Institute, Corning Glass, GTE Laboratories, Honeywell, Hughes Research Laboratories, IBM, Ortel, TRW, and Westinghouse, to name a few. Numerous university groups are also involved; they include the University of Arizona, the University of California, California Institute of Technology, Carnegie-Mellon University, Cornell University, Massachusetts Institute of Technology, Stanford University, Missouri's Washington University, and the University of Washington.



OPTOTRANSMITTER. Developed by Honeywell Inc., this gallium arsenide integrated optoelectronic transmitter/multiplexer combines a laser diode with 36 FET logic gates.

Though such developments as MQW structures and optical bistability in the long term will result in optical logic circuits approaching LSI levels (mostly in specialized designs where cost is no object), it is in the short term that integrated-optics research will have its greatest impact, chiefly as a technology driver for the newly emerging subdiscipline of integrated optoelectronics.

Several applications will benefit from the ability to integrate optical and electronic circuits onto the same monolithic substrate, regardless of the level of integration. One is GaAs-based electronic circuits, where optical interconnection is seen as the only way to move signals around a VLSI circuit for very fast performance. Another is highly parallel supercomputers, which will need optical interconnections between boards using fiber optics and integrated-optoelectronic interface circuits to move data at very high speeds. And wafer-scale-integration-level designs face the same problems at the chip level that supercomputer makers face at the systems level.

Efforts to transfer optoelectronic technology from the laboratory to the production line have been relatively recent. In the U.S., one of the few coordinated efforts is at Battelle Memorial Institute, Columbus, Ohio. Within the last year, a cooperative program similar to the Microelectronics and Computer Technology Center in Austin, Texas, has been organized under Robert L. Holman, a professor of electrical engineering and computer science.

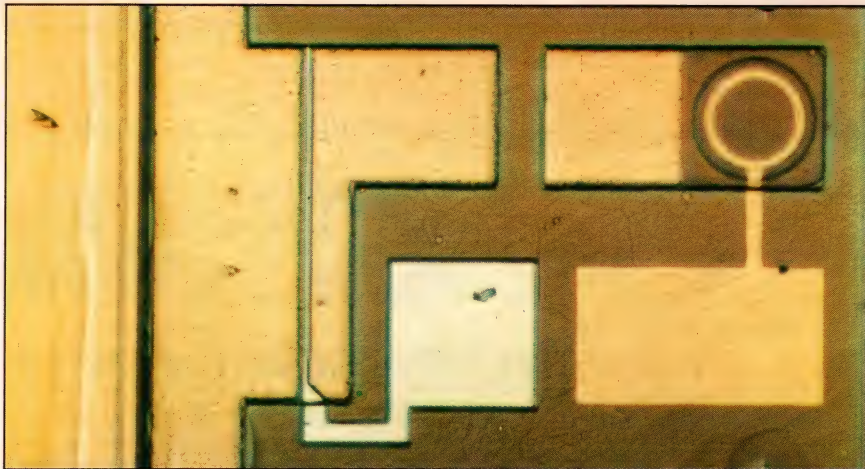
Aimed at developing optoelectronic and integrated-optic manufacturing technology, the Battelle program is seeking funding of \$50 million to \$60 million over five years for several key areas, including microassembly and packaging, substrate production, and electro-optical-circuit fabrication. So far, only one project—microassembly and packaging—has been funded, with \$600,000 over 42 months and sponsored by Allied, Amp, Dukane, Hewlett-Packard, and ITT.

At the pure-research end of the spectrum, an Optical Circuitry Cooperative has been formed at the University of Arizona by Hyatt M. ("Hank") Gibbs. Its aim is to push development of all-optical logic, guided-wave optical processors, and optical interconnection, and is supported by Amp, Celanese, du Pont, GTE, IBM, Lockheed, Motorola, Sperry, 3M, and TRW. Including contributions from the National Science Foundation and the Arizona state government, total yearly funding is \$750,000.

TOO LITTLE, TOO LATE?

Such efforts are puny and tardy compared with Japan's \$70 million, six-year Optoelectronics Project. Now in its fifth year, this program includes a National Optoelectronics Laboratory and 15 participating companies, among them Fujitsu, Hitachi, Mitsubishi, NEC, Sony, and Toshiba. The national laboratory's broad charter is for new processes for growing defect-free GaAs crystals and for fabricating integrated optoelectronic circuits. Each company is responsible for individual projects.

For example, Fujitsu Ltd. is developing multichannel opto-electronic devices that will receive data from fibers, feed it to detectors for conversion to electrical signals, switch channels, and feed driver circuits for laser diodes. At Hitachi Ltd., the focus is on a data-control subsystem that will combine all signal transmissions into a full-scale



REPEATER. One of Ortel Corp.'s first chips combines optical and electronic logic.

optical system that will allow 1-Gb transmission rates.

Mitsubishi Electric Corp. is expected to develop a data-collection system that will take data from many sensors in a loop-type fiber-optic system. And at Toshiba Corp., efforts are under way to develop wavelength-division multiplexing systems for use in process control, in which numerous distributed-feedback heterojunction semiconductor lasers are combined on the same substrate.

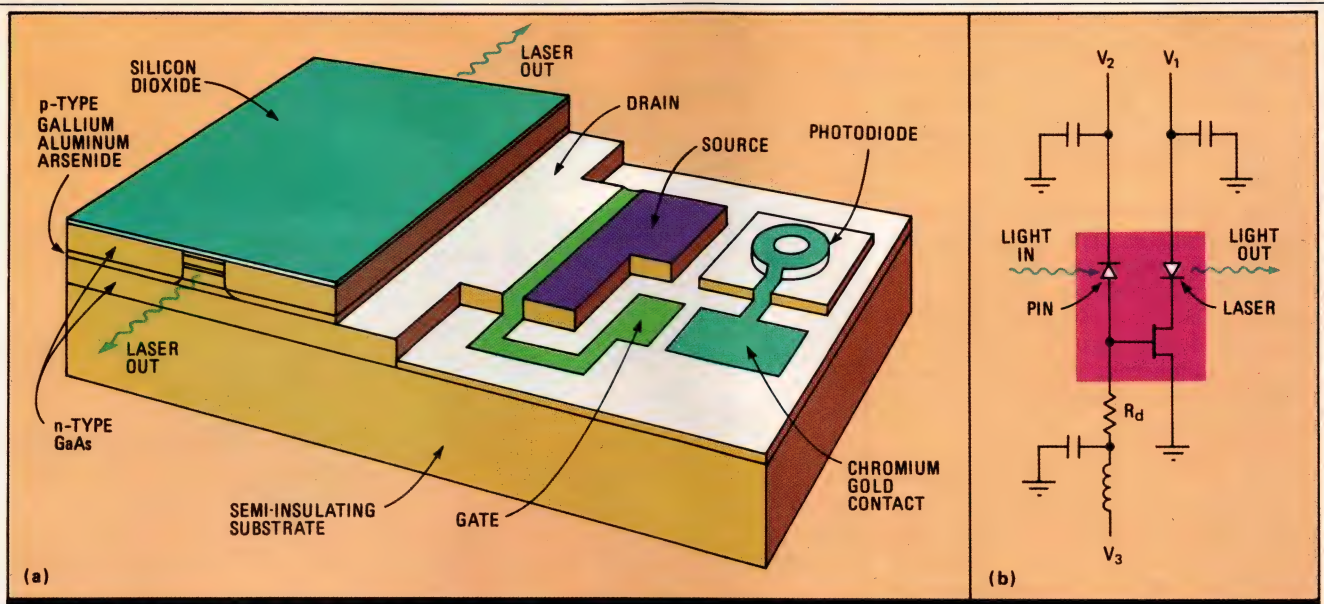
Looking at such efforts by the Japanese, U.S. researchers such as Battelle's Holman express considerable frustration. "While the U.S. has done most of the fundamental and applied research in this area, we are coming from behind as far as turning it into a production-ready technology. And we don't have that much time. For one thing, there are certain technology imperatives, such as the requirement of gallium arsenide circuits for some sort of high-speed interconnect to eliminate the I/O bottleneck. And then, of course, there are the Japanese, who are very serious about dominating this market."

U.S. companies must realize they cannot let the technology evolve and mature at its own pace, he says. "It isn't like semiconductor electronics, where the U.S. until recently was dominant. We don't have 15 or 20 years to let things develop. At most we have five years. After that, we may as well cede it to the Japanese. And they'll deserve it. They've been making the effort and we haven't."

Amnon Yariv of Caltech has similar sentiments. "It is such a waste. We have developed such a storehouse of basic R&D knowledge and until recently have done nothing to exploit it commercially. We are in danger of letting the Japanese walk away with it all." The desire to commercialize the basic research his laboratory has produced led several of his former students to form Ortel Corp. in nearby Alhambra, Calif.

Yariv's research team has developed a steady stream of devices that combine heterojunction GaAlAs semiconductor lasers with GaAs-based Gunn diodes, MES FETs, MIS FETs (metal-insulator FET), bipolar transistors, phototransistors, and photodetectors. Where conventional semiconductor lasers are fabricated on conductive n-type substrates, Yariv's group uses semi-insulating substrates to provide simplified electrical isolation between the optical and the electronic devices on the chips.

In concert with Ortel, Yariv and his group have begun developing a wide range of more complex optoelectronic circuits, including transmitters, receivers, multiplexers, and demultiplexers. One of the first is a monolithic circuit



1. COOPERATIVE CHIP. The Ortel-California Institute of Technology team fabricated a gallium arsenide heterostructure on a semi-insulating substrate structure (a). The circuit combines most of the functions of an optical repeater with a retransmitting laser (b).

(Fig. 1a) that combines most of the basic functions of an optical repeater: detection, current amplification, and a retransmitting laser driven by the amplified signal current (Fig. 1b). Epitaxial layers are grown on semi-insulating GaAs. After mesa etching, p-type and undoped GaAlAs layers are regrown to embed the laser mesa.

The p-GaAlAs layer acts as the laser's leakage-current-blocking layer and as the photodiode's p-type window layer. The undoped GaAlAs layer is selectively etched everywhere except in the photodiodes. Mesa etching down to the substrate isolates the n-gate MES FET channel until the desired thickness is obtained, then the Al is lifted off. The resulting MES FET has a gate length of $2\ \mu\text{m}$ and a gate width of $250\ \mu\text{m}$, with a die size of $325\ \mu\text{m}$.

Using direct-writing electron-beam lithography, researchers at GEC Research Laboratories, Wembley, England, have developed a procedure for integrating optical detector arrays onto the same monolithic substrate as a wide variety of electronic circuits. The detecting elements can be Schottky barrier photodiodes, photoconductive detectors, or optical MES FETs. The amplification circuitry is fabricated from $1\text{-}\mu\text{m}$ GaAs MES FETs with $2\text{-}\mu\text{m}$ source-to-drain spacing. Initial work is aimed at fabricating a 16-element array plus an amplification network operating in the 2- to 3-GHz range.

At the Honeywell Corporate Technology Center, Bloomington, Minn., work is under way using a laser-in-a-well technique to develop optoelectronic transmitters integrating an GaAlAs laser diode onto the same substrate as complex GaAs circuitry. The components in the structure (Fig. 2a) are a transverse-junction-strip laser, a FET laser driver, and a 4:1 multiplexer.

The multiplexer and driver active regions are formed by selective ion-implantation into the semi-insulating GaAs substrate (Fig. 2b). The transverse-junction-strip laser is fabricated in epitaxial layers in a well etched into the substrate. Able to run at 1 GHz, the multiplexer consists of 36 Schottky-depletion FET-logic NOR gates. The driver circuit consists of four MES FETs connected in parallel. The next-generation circuit will include a photodetector and a 500-gate GaAs mask-programmable array to allow customization for particular applications, according to James Carney, one of the circuit's designers.

Compared with the rapid progress toward commercial-

ization of integrated optoelectronics, similar developments in all-optical logic have been slow in coming. Until recently, most approaches to integrating the various elements of an all-optical circuit onto a single monolithic substrate have emphasized an essentially planar methodology similar to that used in MOS circuits, according to Gibbs of the University of Arizona. That is, they have borrowed fabrication techniques from semiconductor electronics. Most optical circuits are laid out horizontally on the surface of a substrate (Fig. 3).

INTEGRATION LIMITS

Using a variety of materials and structures, virtually all the vital elements of an all-optical circuit have been integrated with varying degrees of success onto the same monolithic substrate. The problem, according to William Chang, professor of electrical engineering and computer science at the University of California at San Diego, is that many of these materials and processes are not compatible without considerable modification, thus limiting integration to no more than SSI levels at the most.

For example, he says, optical waveguides have been fabricated using such disparate transparent dielectric materials as glass, photoresist, polyurethane, and such single-crystal materials as lithium niobate, zinc oxide, cadmium sulfide, and GaAlAs. The fabrication processes used to produce such waveguides are diffusion, ion implantation, ion exchange, amorphous-film deposition by evaporation, liquid-phase epitaxial deposition, radio-frequency sputtering, and wet and dry etching. Under investigation are more advanced techniques such as molecular-beam epitaxy, vapor-liquid epitaxy, and metal-organic vapor-phase epitaxy.

Ideally, the aim of all researchers has been to design an integrated optical circuit using a single material in much the same way as electronic circuits are fabricated using a single material, such as silicon or GaAs. Early attempts at integration used GaAs and GaAlAs. However, though GaAs is a good material for semiconductor lasers, GaAs waveguides absorb light from the GaAlAs lasers. As a result, most monolithic integrated-optic devices are fabricated from mixtures of several materials, primarily GaAs, GaAlAs, gallium indium arsenide, gallium indium arsenide phosphide, and indium phosphide.

"The problem with this approach is that the various

devices require different mixtures of the various compounds," says Chang. "For example, the compositions ideal for fabrication of detectors or lasers are useless for waveguides because of the optical absorption at that wavelength."

Thus it is necessary to develop fabrication techniques that allow selective growth of different materials and mixes of materials at different locations on the chip. Moreover, the processes used to connect the components require submicron resolution, something that is not even possible with current silicon-based ICs, he says.

The situation is best illustrated by what it takes to fabricate the simplest of all the optical elements, the waveguide. First, waveguide materials must have little attenuation from lattice vibration and carrier and impurity absorption. Also, the fabrication technique chosen must not introduce surface roughness or volume defects, because these result in scattering, which causes attenuation and limits throughput, as well as noise resulting from the conversion of an optical signal from one mode to unwanted modes.

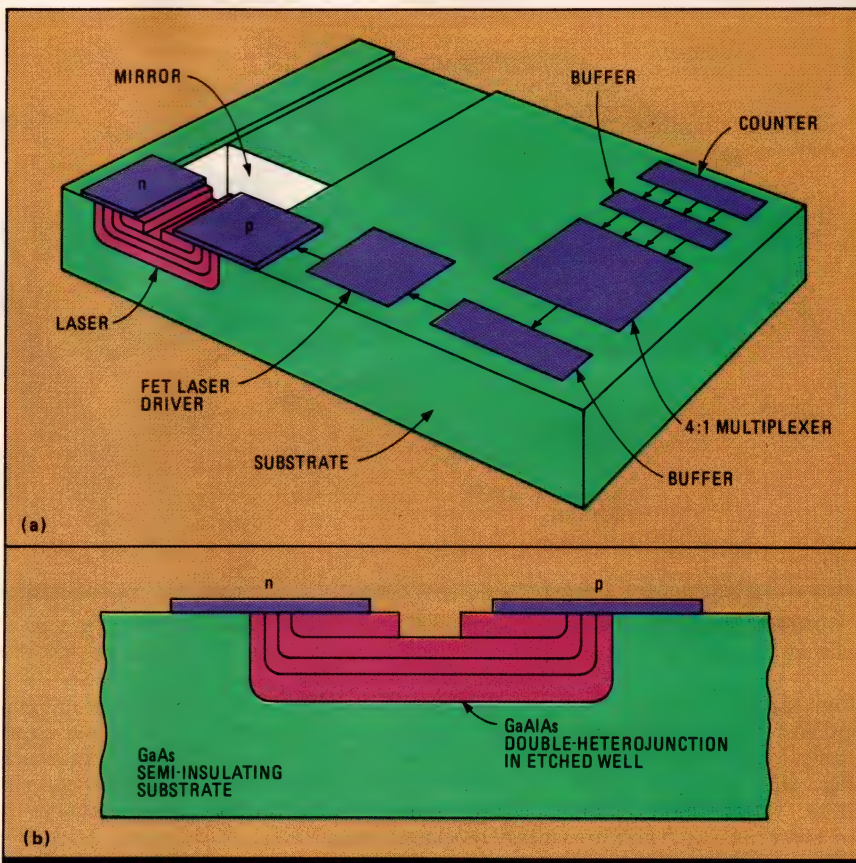
Although standard diffusion techniques result in waveguides on lithium niobate substrates that surpass the performance of epitaxially grown or deposited amorphous-film waveguides, there is both lateral and vertical diffusion into the substrate—a problem at submicron dimensions. Ion implantation allows submicron resolution in the planar dimensions. In the vertical direction, however, it is difficult to implant large atoms such as titanium to much more than 1 μm into materials such as lithium niobate. The technique also damages the waveguide.

Several processing-technology candidates will allow optical-logic elements based on different alloy compositions to be grown on the same substrate with some degree of reliability and reasonable yield and to be connected optically with low loss, says Chang. "However, the most promising—MBE, VLE, and MOVPE—are also the most experimental. While they all offer significant advantages in the fabrication of all-optical-logic ICs, they still have problems as far as production-line processing is concerned."

For example, the advantage of MBE in optical circuits is that it can produce ultrathin, sharp interfaces. Its disadvantage is that the high vacuum needed takes a long time to produce and requires processing in a batch mode instead of the more useful continuous mode.

More important, oxides on the substrate surface degrade the performance of devices prepared with MBE. MOVPE overcomes the limitations of MBE, but is also more complex and harder to handle. "The one promising aspect of all this is that the same epitaxial processing techniques are necessary in the fabrication of nonoptical gallium arsenide circuits," says Chang. "So by the time all-optical logic devices begin to move out of the laboratory, many of the problems with advanced epitaxial growth will have been resolved."

However, many researchers in the field believe traditional approaches to all-optical ICs have limitations that reduce their ultimate usefulness. "No matter how sophisticated and finely tuned they become, optical logic circuits based on thin-film planar processes have certain basic limitations



2. LASER-IN-A-WELL. Honeywell's optoelectronic multiplexer (a) features a strip laser formed in epitaxial layers in a well. The well is etched into the substrate (b).

that will not allow them to achieve the same levels of integration as silicon-based electronic circuits," says Hermann Haus, a professor of electrical engineering at MIT's Science and Research Laboratory of Electronics.

First, the device geometries are several times larger than those of integrated electronic circuits. For example, the cross section of an optical waveguide is on the order of several microns and the length must be on the order of several millimeters to be effective, compared with MOS transistor geometries with gate lengths of 1 μm or less and gate widths of less than a millimeter. Second, optical waveguides are awkward, since it is difficult to bend or cross them. Third, unlike CMOS VLSI logic, with which a switching state can be maintained with virtually no power, optical logic requires continuous light input.

THE PROBLEM OF MAKING SWITCHES

"But most important, compared to electronic circuits, optical nonlinearities are very weak," continues Haus. "This is a serious limitation, since making any sort of switching device relies on nonlinear processes."

In a linear process, the input is directly proportional to the output—if one is plotted against the other on a graph, the result is a straight line. In a nonlinear process, a small linear input results in a sudden, nonlinear kink in the output. In electronic circuits, the transistor provides the necessary nonlinear process to produce an analogous type of switching action in which one set of electrical currents switches another set. There is no way to make a switch without using a nonlinear component.

"The traditional approach to integrated optics has been to achieve the optical analog of electronic circuits, and as such will have application in such areas as communications and signal processing," says Gibbs. "But because they are

designed to mimic electronic circuits, such devices cannot take advantage of some of the unique capabilities of light, in terms of bandwidth and parallel processing."

In view of these basic limitations, research in the last few years has focused on alternatives to the traditional approach, such as MQW devices. These are vertical structures that, in addition to allowing increased density, exhibit nonlinearity features comparable to electronic circuits. What has also excited researchers is that this new structure also exhibits optical bistability. An optically bistable device exhibits two states of transmission—high or low—for a single light input.

MQW devices are essentially periodic superlattice structures, which consist of alternating ultrathin layers of two different semiconductor materials. The layers have different electrical and optical properties but almost identical lattice spacings in their respective crystal structures. This ensures a continuous crystal with few defects. Fabricated using MBE, such structures are designed so that the minimum energy for free electrons is lower in one layer than the other, forcing electrons to gather in the lower energy material, thus creating potential wells. Because the layers are so thin—usually less than 100 Å—the energy levels available to electrons moving at right angles to the boundary between layers are no longer one continuous band but split into several discrete ones.

The bistability occurs because the light transmitted through the material may have two values for a range of incident intensities. This leads to hysteresis, because the transmitted intensity depends on the history of the incident light and not just its current strength. In other words, the MQW device can be in either of two states, depending on previous exposure to light.

BELL'S SUPERLATTICES

Because one optical signal must in some manner affect the transmission of another, an MQW device requires some sort of feedback mechanism to form a switch. At AT&T Bell Laboratories in Holmdel, N. J., researchers have come up with two ways to do this, both based on superlattices consisting of alternating layers of GaAs and GaAlAs.

One is to combine the MQW device with an etalon resonator (also called a Fabry-Perot cavity interferometer), which reflects light many times between two parallel re-

flective structures—either mirrors or gratings—before transmitting it. In this approach, two laser elements are used. One, called the input, is set to the wavelength at which the MQW structure is supposed to be transmitting. The wavelength of the other, called the probe, determines the type of logical operation.

Because of interference caused by light reflecting in the cavity, coherent light emerges with nearly full intensity, provided the length of the cavity is a half-integral number of wavelengths—that is, the resonance condition. Off-resonance light is reflected back to the source with little or no light getting through. By manipulating the relationship between the resonance condition and the increasing or decreasing laser intensity, most of the common logic functions—NOR, NAND, XOR, OR and AND—can be generated. Logic operations take only a few picoseconds, although the

device relaxes to the initial resonance condition after about 5 ns once the pulses pass. The device has been operated with pulse rates up to 100 MHz.

An even simpler MQW structure from the same group eliminates the need for the etalon resonator cavity. Instead it depends on an electro-optic effect where an electric field modifies a material's optical properties to shift the position of the MQW absorption lines by 1%. The shift results from the fact that the quantum wells confine groups of excited electrons and electron groups—called excitons—so the electric field cannot disassociate them.

By keeping the laser-input wavelength fixed, the absorption is modified by a factor of two in the field's presence. Called a self-electro-optic-effect device (SEED), this modified MQW structure consists of 50 layers of 95-Å-thick GaAs separated by 98-Å-thick GaAlAs layers, with thicker buffer and contact layers. One contact layer is n-type, the other is p-type (Fig. 4).

The MQW and buffer layers are nonconductive, resulting in what is essentially a diode—that is, it conducts electricity if the p-type contact is forward biased and does not if the contact is reverse biased. Under reverse bias, the voltage flows mainly across the MQW part of the structure and the resulting electric field shifts the MQW exciton lines to longer wavelengths.

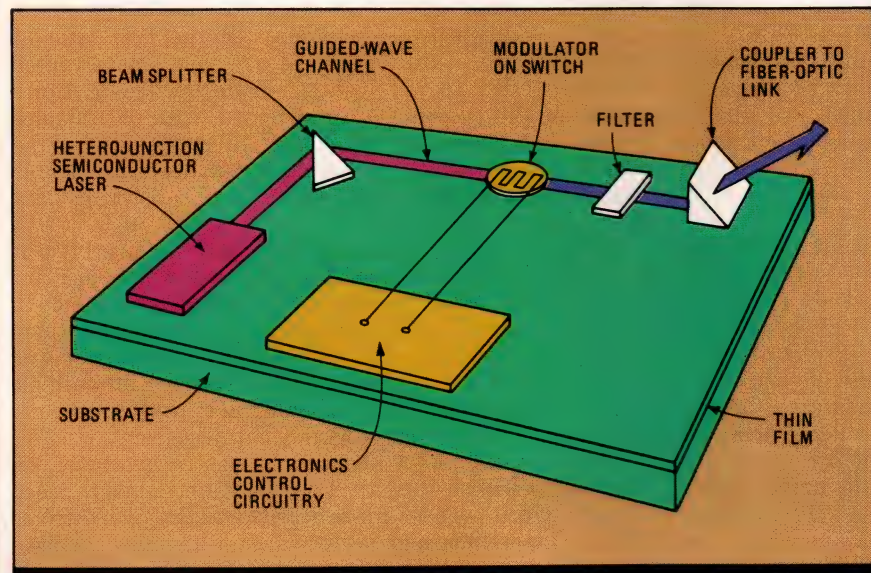
As the laser's intensity increases, free electrons and holes from disassociating excitons lower the resistance of the SEED structure, thus lowering the voltage across it.

The lower voltage returns the exciton absorption line to its normal position. This increases absorption until the exciton line and the laser wavelength are equal, causing the SEED to switch from a high to a low transmitting mode.

At the University of Sheffield, England, researchers have demonstrated an MQW switching device that depends on nonlinear refractive optical properties along the plane of the MQW layer rather than perpendicular to it. It consists of 25 GaAs wells, each 10 μm thick, separated by a similar number of GaAlAs barrier layers, each 300 μm thick. Light is confined to a single mode by total internal reflection in the MQW layer because the refractive index of the GaAs is slightly greater than the GaAlAs. Lateral guiding is done by two thin strips of gold on top of the surface layer, spaced about 10 μm apart.

After evaporation, the strips contract, compressing the quantum-well

Bistable structures lead naturally to parallel logic operations



3. INTEGRATED OPTICS. Integrated optical logic chips combine lightwave sources, modulators, switches, filters, and detectors onto a monolithic substrate.

materials. The photoelastic properties of both materials produce a strain pattern, which creates two closely coupled waveguides between the strips. At low beam intensities, light focused into one guide is progressively coupled into the next one until it emerges from the opposite guide. As the light's intensity increases, coupling becomes progressively less efficient until eventually no light is coupled across. Instead, it goes straight through the device along the first guide.

"The advantage of bistable structures such as etalons and MQW devices is that they lead naturally to parallel logic operations, taking advantage of the parallel propagation and the imaging properties of light," says Gibbs, who codiscovered the bistable effect in lasers while at Bell Labs in the early 1970s. "They can be used with all optical inputs to form a variety of logic gates for optical memories or as optical transistors."

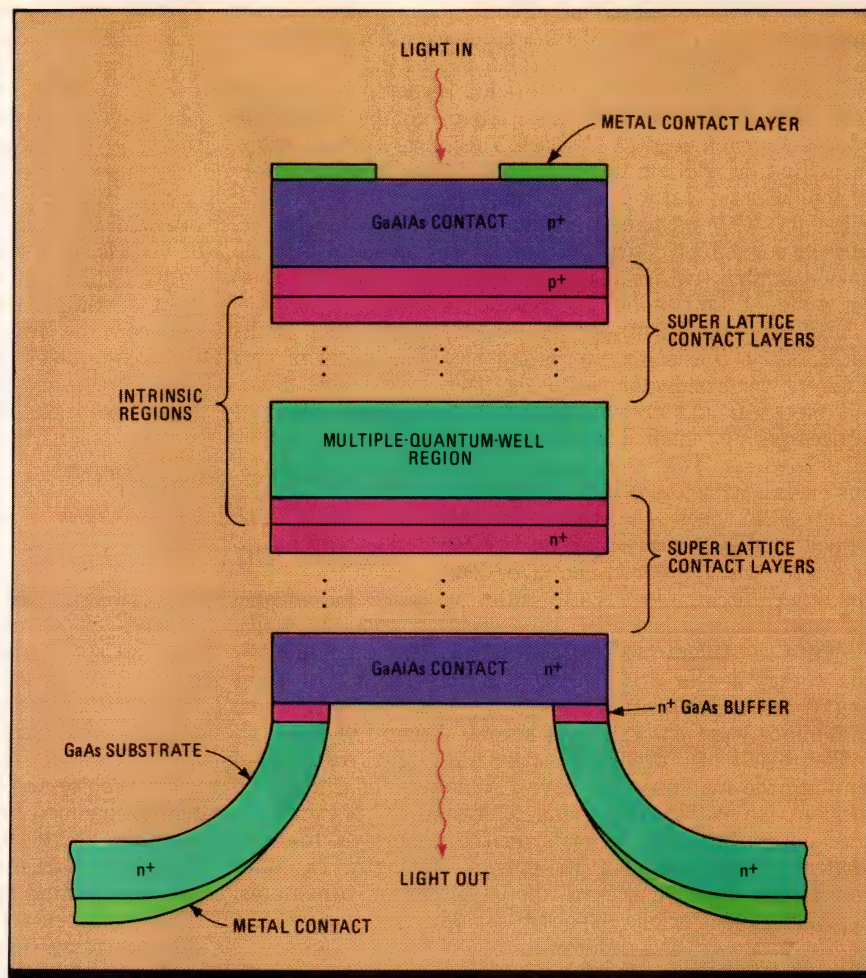
Their sensitivities heightened, optical logic investigators have been looking for—and to their surprise, finding—other examples of the bistability effect. A team at the University of Virginia has developed an integrated bistable optical modulator design based on GaAs-clad dielectric-waveguide technology [*Electronics*, Oct. 28, 1985, p. 16]. They have found that the required damping of an optical wave's phase can be achieved by adjusting either the material's absorption or the cladding's thickness. One of the keys to their design is the periodic coupling, or transfer of energy, between the propagating low-loss guided modes of a dielectric optical waveguide and the high-loss modes supported by a semiconductor cladding layer.

Researchers at the Agency of Industrial Science and Technology, Sakuramura, Japan, are investigating new types of bistable optical devices consisting merely of laser diodes and/or light-emitting diodes and photodetectors, using a GaAlAs compound on a single p-type GaAs substrate. Using an n-n-n double heterostructure and combining it with metallic contacts and a zinc diffused p+ layer to provide a transverse-junction-strip geometry, a variety of logic elements can be constructed and combined to form more complex devices.

TWO KINDS OF LOGIC

At GTE Laboratories, Waltham, Mass., Jai-Ming Liu and Ying-chin Chen have developed a complete set of optical AND, NAND, OR, and NOR gates and clocked optical SR, D, JK and T flip flops. These are based on direct-polarization switching and polarization bistability in v-groove-substrate buried-heterostructure InGaAsP/InP. Semiconductor lasers with 1.3- μm wavelengths are fabricated on the same substrate that holds optoelectronic switches and photodetectors. With this technique, two logic operations are possible: intensity-defined logic, in which the binary states are defined by the level of light intensity disregarding polarization, and polarization-defined logic, in which one polarization plane is defined as a 1 and another as a 0.

In the direct-polarization switchable mode, the laser's output can be switched directly between the field perpen-



4. MULTIPLE QUANTUM WELLS. High levels of logic integration may be possible using superlattices of alternating thin layers of gallium aluminum arsenide and GaAs.

dicular and field parallel to the junction, with optical logic gates constructed from two optoelectronic switches or photodiodes. In the polarization bistable mode, the laser is always functioning and thus it can change state without a change of carrier density.

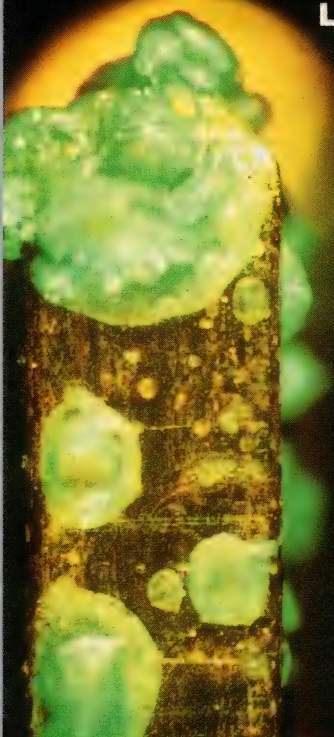
Therefore, the switching speed of each element is, in principle, limited only by the response time of the photodiodes or optoelectronic switches. In the first type of logic operation, switching times are instrument-limited to about 1 ns. In the bistable mode, switching times depend on the photodiodes or switches. With photodiodes or switches operating in the 100- to 200-ps range, the overall bistable switching speed is less than 1 ns. This means it can work at well over 100 MHz, allowing data rates close to 1 Gb/s.

"It's really quite surprising," says MIT's Haus. "It's as if one day we were looking at a brick wall wondering how to get around or over it, and the next day found a hole in it that allows us to push right through. There was nothing in the rules we had built up that predicted such effects as optical bistability in semiconductor lasers and multiple quantum wells. Then all of a sudden they were there, not just in one material or structure, but all over."

There are still fundamental problems to overcome, he says, and it will be some time before all-optical logic based on such effects will be a practical alternative to electronic circuits in certain high-performance computing applications. "But now we can be sure that it will happen," says Haus. "It is also leading some of us to ask ourselves, what other pleasant surprises does nature have in store?" □

Gold is second best to new RN plating technology!

**GOLD
LOSES!**

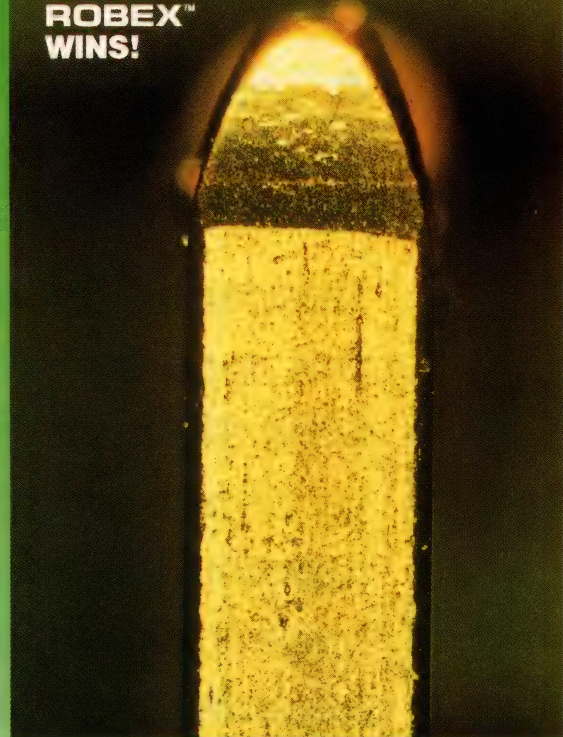


ACTUAL MICROPHOTOS
of two plated header pins after
1-hour nitric acid porosity test.

ROBEX™ plated contact (30 μ in.)
Contact resistance remains constant.
Header pin remains bright, shiny,
free from corrosion of base metal.

GOLD plated contact (30 μ in.)
Contact resistance goes up because
porosity of gold plating allows
corrosion product from base metal
to migrate to surface.

**RN
ROBEX™
WINS!**



New ROBEX™ plating puts gold to shame in punishing IDC connector reliability tests

Get ready to change your mind about the best way to achieve solid connector reliability. Gold is no longer the ultimate answer. These microphotos reveal surprising facts about the damaging porosity of gold plating. They also show how the non-porous nature of the revolutionary new Robinson Nugent **ROBEX™** palladium-nickel plating system offers a higher degree of connector reliability than gold will ever provide. Levels of reliability and stable contact resistance heretofore obtainable only through the use of high cost, thick gold plating can now be achieved with this new **ROBEX™** plating system.

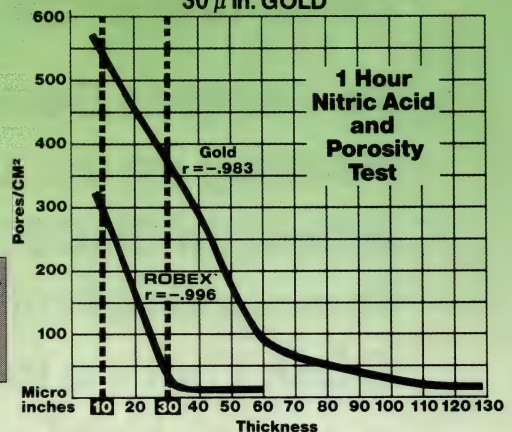
This new **ROBEX™** plating system minimizes porosity, increases environ-

mental corrosion resistance, increases wear resistance and improves solderability.

MAKE THE CHOICE! Decide now to realize the advantage of the plating technology of the future. Call Robinson Nugent and ask us about **ROBEX™**. We'll send you a detailed technical brochure on this new revolutionary RN **ROBEX™** plating system. You may never specify costly gold plating again! Contact: Robinson Nugent, Inc. 800 E. Eighth St., New Albany, IN 47150. Phone: (812) 945-0211.



**10 μ in. ROBEX™ OUTPERFORMS
30 μ in. GOLD**



Circle No. 45



Robinson Nugent

800 East Eighth Street, New Albany, Indiana 47150 • Phone: (812) 945-0211
In Europe: Rue St. Georges 6, CH 2800 Delemont, Switzerland • Phone: (066) 22 98 22

SIEMENS

A jump ahead in telecom ICs for ISDN.
Digital communications needs a total concept.
It comes from Siemens.

Telecommunications in future means ISDN, with the need for densely integrated devices. Like those from Siemens, brimming with innovation, ultra-modern microelectronics, backed by end-to-end capability in semiconductor technology. Plus the benefit of synergetic spin-off, i.e. from the systems experience of all the company's different divisions.

Ripe ground for pioneering achievement, like a total VLSI concept for telecommunications. With its new-style circuit architecture it sets new standards.

At Siemens Components Group we're working on the telecom future. With a force of 26,000 employees and thousands of millions going into R&D. That's a foundation our customers can build on, worldwide.

Everything it takes in electronics.
Siemens.



The Siemens IC concept as basis for ISDN: The S-bus interface circuit (SBC) integrating 10000 transistors on 15 mm² area, and the ISDN echo cancellation circuit (IEC) with 60000 transistors on a 45 mm² chip for public telecom networks. In private telecom systems

ISDN is implemented through the SBC or the ISDN burst controller (IBC) which integrates 13000 transistors on 18 mm² area. In both networks data is transmitted by the ISDN communications controller (ICC), a device with 20000 transistors on 18 mm² chip area.

The Siemens device concept for basic access to ISDN is made up of four VLSI ICs

which are based on 2 μ m CMOS technology. They satisfy world market require-

ments and provide utmost flexibility for the needs of telecom system suppliers: an

IOM interface allows the combination of the most diverse types of ICs.

VLSI telecom devices from Siemens create all-digital communication of voice, text, image and data. Densely integrated chips as basis access to ISDN.

Siemens AG,
Components
Group,
Balanstr. 73,
D-8000
Munich 80

**EUROPE'S
COMPUTER BUILDERS
CAN NOW WORK WITH
THE MOST POWERFUL
MICROPROCESSOR ON
THE WORLD MARKET.**

A computer may awe you with its memory, delight you with its graphics and dazzle you with its speed, but deep down inside, the brain behind it all is its microprocessor.

And the Motorola MC68020 is the most powerful computer microprocessor available on the world market today.

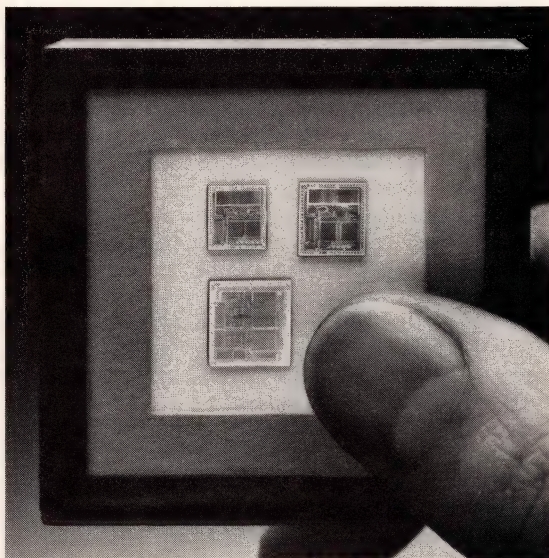
This remarkable 32-bit chip can access over 4 billion bytes of data. Its processing power is equally prodigious, more than 2½ million instructions per second. It is also fully upwardly compatible with our earlier 16-bit machine and it completes a progression of 8-, 16-, and now 32-bit members of a single Motorola family of microprocessors. This enables product designers to expand the capabilities of their hardware without the interruption of a radical redesign.

The MC68020 is already destined for great accomplishments. It seems likely it will be a major factor in the market for use in the next generation of robotics. Its potential for high speed graphics and advanced mathematics make it ideal for high volume data processing, complicated computer-aided design and manufacturing (CAD/CAM) processes and next-generation general purpose computers.

We believe this microprocessor can make a meaningful contribution to Europe's already significant participation in the "information age." And, of course, we have a vital stake in that participation.

We operate major production facilities and design centers in the United Kingdom, the Federal Republic of Germany, France and Switzerland and have more than 80 offices serving Europe.

Worldwide, Motorola is a \$5.5 billion (U.S.) electronics company doing business on five continents. We number 100 thousand people, and we share a deep dedication to the service of our customers in voice and data communications, computers, semiconductors and components for defense, aerospace, automotive and industrial electronics.



Our family portrait.



MOTOROLA A World Leader in Electronics.

AN ECONOMICAL WAY TO HANDLE DIGITAL TV SATELLITE SIGNALS

PROCESSOR STOPS ATMOSPHERIC DISTORTION, ADDS SIGNAL SECURITY

Up until now, television broadcasting companies moving into satellite transmission have had to use analog signal processing because of cost considerations. Even so, this approach required the use of expensive, power-hungry bipolar circuitry, and it failed to provide the signal security deemed vital by broadcasters, who want to deny access to their communications links to nonpaying users of low-cost satellite receivers. What's more, analog signal-processing systems are sensitive to atmospheric distortion.

The best technical solution to this problem would be digital signal processing. However, the large bandwidth required to achieve the high sampling rates needed for the job would mean using the equivalent of a high-speed, supercooled supercomputer, such as a Cray-1, or an array processor—expensive alternatives, in terms of both initial cost and upkeep.

Now DSP Systems Corp. has come out with a lower-cost solution—a VMEbus-compatible vector processor called the GOPS, for giga-operations per second. The system from the Anaheim, Calif., company uses sophisticated signal-processing techniques to eliminate the effects of atmospheric distortion and to facilitate signal encryption and decryption. It can continuously process 20-MHz analog data digitized to an accuracy of 8 bits. The GOPS can be used for any application that requires the real-time processing of analog data at speeds up to 50 MHz, says company president and codeveloper Louis Schirm IV. "But it will initially have its greatest impact in broadcasting since it allows digitization of satellite video signals in real time and does it with components and boards built around standard state-of-the-art low-power CMOS components and bipolar logic."

TECHNOLOGY TO WATCH is a regular feature of Electronics that provides readers with exclusive, in-depth reports on important technical innovations from companies around the world. It covers significant technology, processes, and developments incorporated in major new products.

In satellite applications, the GOPS processor can encode the transmitted signal and decode the received one to provide a secure communications link. And the processor can simultaneously serve as an adaptive filter to eliminate the effects of atmospheric distortion, says Schirm. "As such, the GOPS can be used as a more efficient digital replacement for the analog processors now used in signal enhancement and encryption of satellite TV signals."

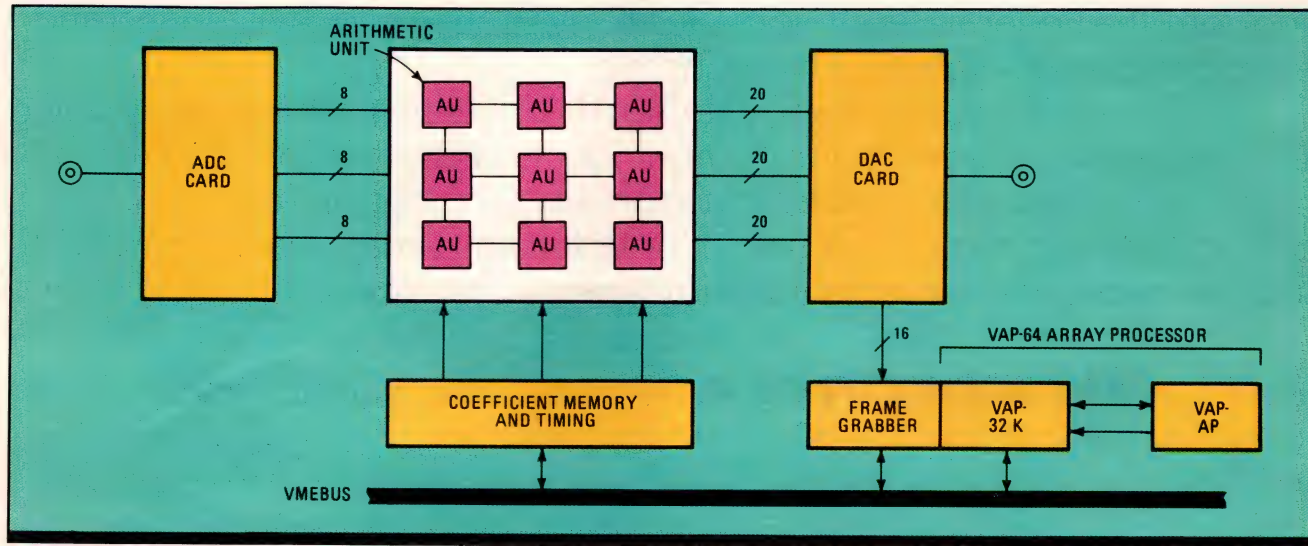
The processor is designed so that the arithmetic-unit modules that are at the heart of the processor can be configured in parallel or cascaded to form finite-impulse-response filters of varying lengths to accommodate sampling rates up to 50 MHz. The processor operates either sequentially or in parallel at speeds in excess of 7 giga-operations (7×10^9 operations) per second when functioning as an FIR filter; this is about 65 times faster than a general-purpose Cray-1 supercomputer performing the same operation.

A typical GOPS configuration has fewer than 20 VMEbus-compatible boards and occupies no more than 1 ft³. In addition to signal encryption and decryption, it performs all the necessary functions required for digitally processing satellite TV transmission—including filtering, auto- or cross-correlation, adaptive equalization, and line enhancement.

FLEXIBILITY IS KEY

Key to the flexibility and power of the GOPS processor is a highly flexible proprietary architecture that can be configured to operate in a serial, cascaded fashion or in a massively parallel manner, using only seven basic VMEbus-compatible boards: the arithmetic unit, an analog-to-digital converter, a digital-to-analog converter, a coefficient memory and timing card, a frame grabber, a variable-delay module, and a two-board array processor.

A system with one arithmetic-unit board can be configured to operate as a 24-tap 16.7-MHz FIR filter capable of 0.8 giga-operations per second. Arranged in parallel, two arithmetic units yield a 24-tap, 33.3-MHz filter, and three of them raise



1. MATRIX PROCESSOR. With a matrix of nine specialized arithmetic units, the GOPS processor runs at up to 7.2 giga-operations/s.

the sampling rate to 50 MHz at 2.4 giga-operations. Arranged serially, two cascaded units offer 48 taps and 1.6 giga-operations, and three provide 72 taps and 2.4 giga-operations. Further, says Schirm, when configured into a two-dimensional matrix (Fig. 1), a GOPS system can be operated in both serial and parallel modes, either as a 72-tap, 50-MHz, 7.2-giga-operations FIR filter or as a 312-tap, 17-MHz, 10.4-giga-operations FIR filter.

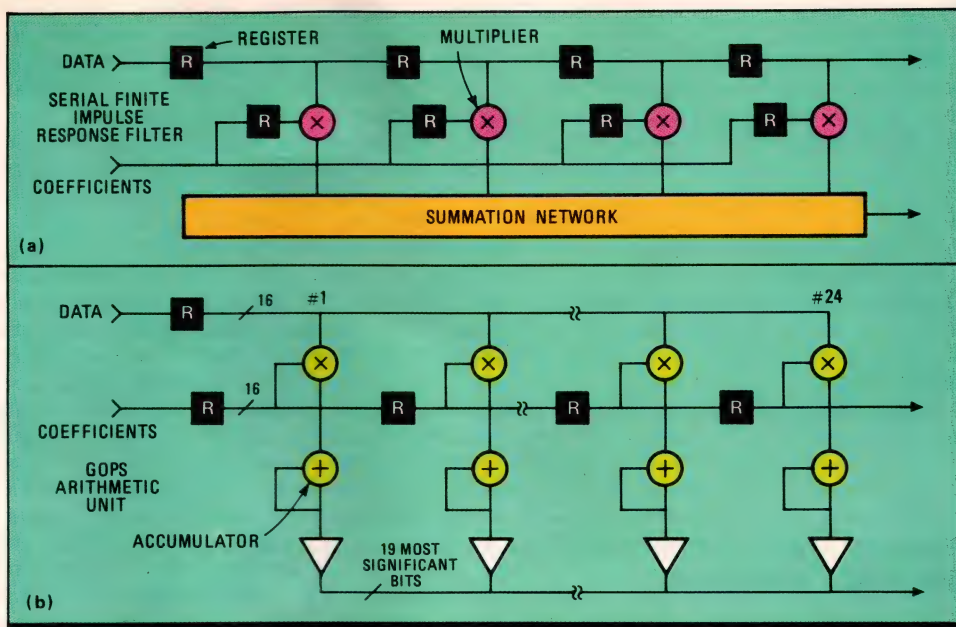
The linchpin in the GOPS system is the arithmetic-unit board, which incorporates the basic filter building block having circuits organized into an FIR configuration. The standard FIR-filter implementation (Fig. 2a) uses a serial string of multipliers. During a normal operation, coefficients stored in memory are loaded into the multipliers at the same time a string of registers is loaded with incoming data. The two strings are multiplied together; the result is sent to a summation network, where the individual results are added together and sent to the output.

In the DSP Systems approach (Fig. 2b), coefficients and data are loaded into the arithmetic unit in parallel through the 16-bit-wide multiplier-accumulator circuits. The shift registers, rather than being located on the data-input side, are placed in the coefficient path. Instead of using the registers to slow the input data until the coefficients in the multiplier are ready, the GOPS does the reverse, says Schirm. The coefficients are held in registers and presented to the multipliers at the same time the data is loaded into the accumulators, using the same clock.

In the actual board layout, 24 off-the-shelf CMOS multiplier accumulators provide the multiplication and summation functions and are combined with a similar number of pipeline registers, programmable scalars, and saturation logic at the outputs. These are all fed by an internal 16-bit data-input bus. All multiplications are 16-bit, and all data-input, coefficient, and data-output formats are fractional-2's complement. Accumulations are performed with 35 bits of accuracy, providing four bits of growth beyond the basic 31-bit double-precision product. The top 19 bits of the accumulations are returned to the output bus with the sign and four integer bits at the most-significant-bit end followed by 15 fractional bits.

Without the need for extra logic, the output format has a built-in divide-by-2 as compared with the input, says Schirm. Final results are either rounded or truncated to 20 bits initially, then reduced with the programmable scalar and saturation logic to 16 bits for the final digital output. In certain configurations of multiple arithmetic units, the card outputs are summed, requiring the inclusion of adders on each board, says Schirm.

As with all the boards in the GOPS, the arithmetic unit has been designed to keep the need for high-speed high-power bipolar logic to a minimum, according to Schirm. All internal logic functions are performed with subnanosecond-gate-delay CMOS logic. Fairchild bipolar Advanced Schottky TTL is used only at the output to reduce delay time between boards. Power dissipation for one fully populated arithmetic-unit board is only 24 W, or about 30 mW per mega-operation, versus several hundred watts' dissipation for traditional arithmetic-unit implementations that use high-speed



2. PARALLEL. Standard FIR filters load coefficients into multipliers and incoming data into registers simultaneously (a). The GOPS approach loads both strings into the arithmetic unit in parallel (b).

high-power ECL to get high processing speed, says Schirm.

A minimum system for TV satellite-transmission applications would be a 3-by-3 matrix consisting of nine arithmetic units, an ADC, three variable-delay modules, coefficient memory and a timing card, a frame grabber, a fixed-point 16-bit mini-array processor, and 32- to 64-K words of dual-port cache random-access memory, according to Schirm.

One set of data inputs in this matrix is necessarily limited in size to multiples of 24, or less by filling in zeros. This set is stored in the coefficient memory before beginning the calculations and can be updated while operations are going on without changing other words or resetting any values. The other set of inputs to the matrix can be, but does not necessarily have to be, infinite—that is, the inputs can come from a real-time source. Within certain limits, the arithmetic-unit boards are configurable by the backplane wiring, Schirm says. Each board can do 24 simultaneous multiplications and double-precision additions on each cycle of a 15- to 20-MHz clock. One output is delivered for each input.

REAL-WORLD CONNECTION

The ADC board is the front-end real-world connection of the GOPS system and is built around an 8-bit TRW TADC1025 flash converter that can run at up to 50 MHz. Because the arithmetic units are designed to run at 15 to 20 MHz, the output of the ADC is split into three parallel 8-bit buses that feed into one set of inputs to the arithmetic-unit matrix. Depending on the application, these inputs could also feed first into a variable-delay module.

Running at 16.7 MHz, the variable-delay module contains 512-K words of dual-port dynamic RAM. One port always writes new data, and the second port always reads data a user-specified number of clock cycles after the write operation. "A good way to think of it is as a variable-length shift register, which has the basic function of forcing the GOPS to select samples over a time period or frequency range the user thinks is statistically significant," Schirm says.

The other set of inputs to the arithmetic-unit matrix comes from the coefficient memory and controller board containing a dual-ported RAM for the coefficients and system-control logic. It also contains a continuously running counter for reading the RAM and sending coefficients to the inputs of the arithmetic units. The RAM is configured into three parallel mod-

ules, each 16 bits wide by 2-K bits long, for a maximum of 6-K coefficients.

Final arithmetic results from the arithmetic-unit matrix are typically passed to the reformatter and DAC board in word sizes up to 20 bits through the three outputs from the matrix: the results are converted to analog form after combining them into a single data stream. Under software control, a four-position multiplexer selects the 16 best out of the original 20 bits. It then performs programmable scaling, generating the results of the matrix calculations and dumping them onto a high-speed, 16-bit-wide, 50-MHz bus to the frame grabber. The same result is also sent to an on-board 8-to-1 multiplexer, from which the user can select which 8 of 16 bits to send to the DAC circuit for conversion of the TV signal back into analog form.

In most cases, the GOPS will perform a number of tasks on the transmitted satellite signals—filtering, adaptive equalizing, and other continuous real-time tasks. To digitally monitor the progress of such operations, the GOPS includes a frame-grabber board, which can capture up to 32-K words of the fast output data from the reformatter and DAC board.

MINI-ARRAY PROCESSOR

The user programs the GOPS with a mini-array processor, such as DSP's VAP-64, to perform the various signal-processing applications required in the digital transmission and reception of TV satellite signals. It is a fixed-point 16-bit processor built around CMOS 2901 bit-slice arithmetic logic units that perform 10 mega-operations per second.

Using the samples obtained from the frame grabber, the operator can perform complex signal-processing analysis functions on the signal, determine the problem, and specify what modifications to the FIR algorithm are necessary. With up to 64-K words of cache memory, the VAP-64 provides more than enough storage for the vast majority of signal-processing applications. If additional memory is required, 64-K blocks of memory can be downloaded to the VAP-64's cache memory from a host computer.

Under program control, the GOPS can perform all the func-

tions necessary in the processing of TV satellite signals (line enhancement, auto- and cross-correlation, adaptive equalization, and adaptive filtering). For example, when configured as a dual-input adaptive filter, the GOPS can cancel out the effects of noise and other unwanted signals, according to Schirm. Using the variable-delay module, the GOPS would select a channel with known information and compare it with the channel with the noisy signal, superimposing the two to eliminate the noise.

Though the GOPS processor will find immediate application in the TV satellite-transmission industry because of its high cost-performance ratio and small size, its ability to provide a sophisticated encryption capability might be its most significant contribution. According to Schirm, the major stumbling block of analog signal processing has been keeping the TV signals to and from the satellite sufficiently secure.

One simple way to do this with the GOPS is to encode the transmitted signal with enough amplitude and phase to render the composite signal useless to someone who does not have the correct receiver, he says. The received signal is cleaned up with the adaptive filter, which is given coefficients for the inverse of the encoding filter.

"With analog signals, all you can do is scramble the signal," says Schirm. "And anyone with little more than a hobbyist's knowledge of analog and linear design can play around with the signals, tweak this component and that, and within a short time figure out how it's being done. And if enough people figure out how it's being done, or if someone starts selling a little black box, the broadcaster has to make a decision either to change the hardware—a not-inexpensive alternative—or live with the problem."

With the digital-processing approach, the encryption algorithm can be buried somewhere in the code and changed as little or as often as the broadcaster wants. "With the digital approach to processing satellite TV signals," says Schirm, "the investment the potential airwave pirate must make is much higher. Not only must he know about electronics, he will also need to have a fairly sophisticated knowledge of mathematics." □

SCHIRM AIMS TO DEMYSTIFY DIGITAL SIGNAL PROCESSING

For DSP Systems president Louis Schirm IV, the GOPS vector processor proves his long-held belief that digital signal processing need not be expensive, complex, or require a knowledge of filters, fast Fourier transforms, and other esoterica. "After he has defined his problem, a designer should be able to go to a catalog and pick out a set of standard boards that best fit his needs, plug them into a commonly available bus, and be up and running," he says.

In 1980, with this in mind, the 37-year-old California native formed DSP Systems Corp. in Anaheim, which has grown into a multimillion-dollar company offering a broad line of digital signal-processing boards and development systems.

Very much a hands-on president and chief executive,

Schirm, a BSEE graduate of California State Polytechnic University in Pomona, spends as much time on design and development as he does on marketing and sales.

Schirm gained his experience in signal processing as a designer and applications engineer on numerous military projects at Rockwell International Corp. and TRW Inc., and is the author of more than 25 technical papers and articles on the subject.

In the case of GOPS, the overall concept and architectural features were Schirm's, as were the design of the arithmetic-unit board. Overall design and implementation of the system and the other boards were the responsibilities of engineer Richard deKoeper and engineering technician David Lilly.

Also a California native, the 25-year-old deKoeper was

born in Fullerton and received his BSEE degree from the same school as Schirm. The newcomer to the company's design team is the 25-

year-old Lilly, who will graduate in December with a degree in electrical engineering from California State University at Fullerton.



SCHIRM'S TEAM. Richard deKoeper, Louis Schirm, and David Lilly designed DSP Systems' matrix processor to be easy to use.



Technology and Service

For The Best In Power Transistors Call The European World Power



Now the European world power is becoming even more powerful. An extensive 4 year investment program in power transistor production, backed by an expanded pan-European commercial network, has won SGS a major slice of the European power transistor market. And an aggressive product expansion program now aims to put the European power at the very forefront of the world's markets.

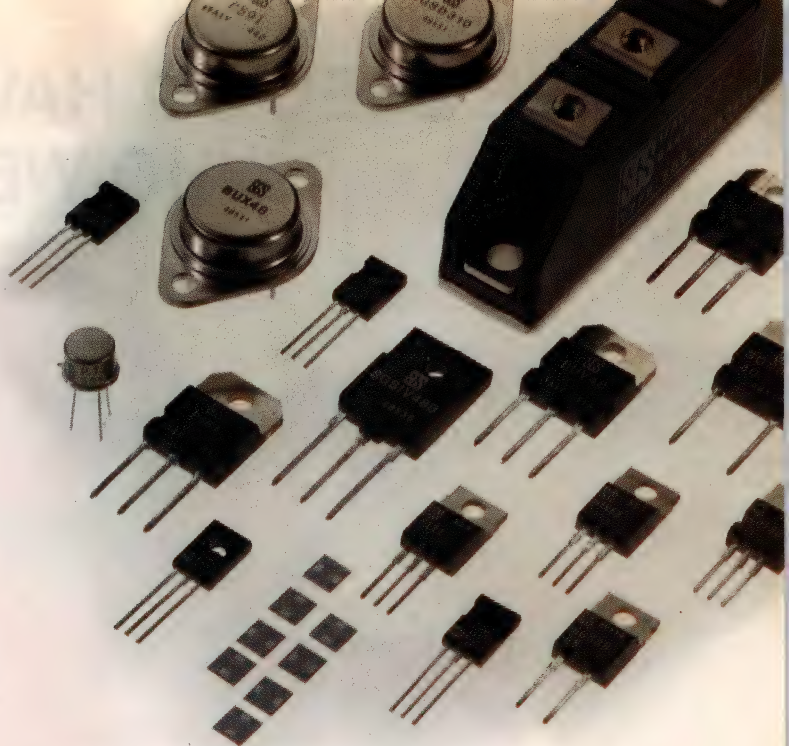
INTERNATIONAL HEADQUARTERS SGS Microelettronica SpA, Via C. Olivetti 2 - 20041 Agrate Brianza - Italy. Tel: 39-65551 Telex: 330131-330141-SGSAGR •
Benelux SGS Microelettronica SpA Sales Office: Bruxelles 1040, Bld. Reyerslaan, 207-209 Tel: 2-7366060 Telex 24149B • **Brazil** SGS Semicondutores LTDA Sales Office: 05413 São Paulo, Av. Henrique Schaumann 286-CJ33 Tel: 11-853-5062 Telex: 37988 UMBR BR • **Denmark** SGS Semiconductor A.B. Sales Office: 2730 Herlev, Herlev Torv, 4 Tel: 2-948533 Telex: 35411 • **France** Société Générale de Semiconducteurs, 92120 Montrouge, 21-23 Rue de la Vanne Tel: 1-47460800 Telex: 250938 F •
Hong Kong SGS Semiconductor Asia Limited, Hunghorn, Kowloon, 9th Floor, Block N, Kaiser Estate, Phase III, 11, Hok Yuen St. Tel: 3-644251/5 Telex: 63906 ESGIE HX •
Italy SGS Microelettronica SpA Direzione Italia e Sud Europa, 20090 Assago (MI), V.le Milanofiori - Strada 4 - Palazzo A/4/A Tel: 2-8244131 (10 linee) Telex: 330131-330141 SGSAGR
Korea SGS Semiconductor Asia Limited, Korea Liason Office: Mapo, Seoul 121, Rm 1306 KMIC Bldg, 168-9 Yumildong Tel: 712-7071/2/3 Telex: K 26493 •

POWERFUL PRODUCT RANGE

Breaking the "1000 type" barrier in 1984, the SGS Power Transistor range is growing at more than 3 new types a week to cover all aspects of power technology.

DMOS transistors for ultrafast switching applications, proprietary FASTSWITCH bipolar devices for 50W to 500W off-line switching power supplies and the SGS TRANSPACK 35kVA power modules are just some of the powerful solutions developed and made for you in Europe - and there's more.

SGS, with its ISOWATT218 isolated package, aims to be the first western manufacturer to offer "user friendly" replacements of the TO-218/SOT-93 or TO-3P medium power devices. And a new range of fast epitaxial diodes up to 1200V breakdown and 50A rms. complement the faster switching power transistors now being designed-in.



Over 1000 devices with a wide range of packages offers the optimum trade-off between economy and performance for all your applications.

COST EFFECTIVE

Price, Performance, Quality and Service are the four main elements of truly cost effective power transistors. SGS is the European supplier with the most significant presence on worldwide markets to give the levels of production volume that translate into lower costs, and we've enhanced this with investments in advanced 5" diffusion facilities for power transistors. SGS' advanced silicon and packaging technologies guarantee you the best in power transistor performance, while with 100% in house epitaxial growth,

100% in-house epitaxial growth gives SGS complete quality and process control from the very start of production.



the key to all modern power transistors, SGS has complete quality and process control from the very start of production.

And Service?

RIGHT HERE IN EUROPE

SGS is right here in Europe with full production and a pan-European marketing organisation. What's more, SGS has a dedicated team of more than 100 engineers and technicians working on R&D in the power transistor field. This expertise too is right here in Europe working on your future needs in power technology. A concrete example of the teams' success is the reachable cost and ready availability of the FASTSWITCH series of 1000V ultrafast switching transistors. Compare these to the 500V power MOS offered by our American competition and you'll see why the European power means technology and service.

The European World Power.



Singapore SGS Semiconductor (Pte) Ltd., Singapore 2056, 28 Ang Mo Kio, Industrial Park 2 Tel: 482-1411 Telex: RS 55201 ESGIES • **Spain** SGS Microelettronica SpA, Representative Office: 28036 Madrid, Calle Agustin de Foxá, 25 Tel: 1-7337043 • **Sweden** SGS Semiconductor A.B. 19500 Märsta, Bristagatan, 16 Tel: 760-40120 Telex: 54 10932 • **Switzerland** SGS Semiconductor S.A. Sales Office: 1218 Grand-Saconnex (Genève), Chemin François-Lehmann, 22 Tel: 22-986462/3 Telex 28895 • **Taiwan-Republic of China** SGS Semiconductor Asia Limited, Taipei Sec 4, 6th floor, Pacific Commercial Bldg, 285 Chung Hsiao East Road Tel: 2-772 8203 Telex: 10310 ESGIETWN • **United Kingdom** SGS Semiconductor Limited, Aylesbury, Bucks, Planar House, Walton Street Tel: 296-5977 Telex: 51-83245 • **USA** SGS Semiconductor Corporation, Phoenix, AZ 85022, 1000 East Bell Road Tel: (602) 867 6100 Telex: 249976 SGSPH-UR • **West Germany** SGS Halbleiter Bauelemente GmbH, 8018 Grafting bei München, Haidling, 17 Tel: 8092-690 Telex: 05 27378.

WE USED TO HAVE TO EXPLAIN WHO WE ARE.



Now everyone knows that Zincocelere products, like those of Nord Elettronica and CSI, are part of the newly formed Teknecomp Group. Teknecomp offers the expert personnel and the advanced research and manufacturing technology need to produce superior components for today's professional electronic products.

Come talk to the largest, most responsive source in Europe for high tech, high density multilayer printed circuit boards.

TEKNECOMP

TEKNECOMP S.p.A.
Zincocelere Division Direzione
Head office and Factory:
Via A. Bertone 12 - 13042 Cavaglià (VC)
Tel. (0161) 96195/6/7/8 - 966101
Telex 200039 ZINCO I

NORD ELETTRONICA S.p.A.
Head office and Factory:
17041 Altare (Savona)
Località Molino Vecchio
Tel. (019) 584031
Telex 213172 NOEL I

C.S. ITALIA S.p.A.
Head office and Factory:
Via Druento 274
10078 Venaria Reale (Torino)
Tel. (011) 4240884
Telex 220545 CSI



**FULLY ENCLOSED
BUT PRICED LIKE IT WASN'T**

**KEPCO/TKD SERIES EMR ENCLOSED AND SHIELDED
SWITCHING POWER SUPPLIES**

KEPCO/TDK

Series EMR fully enclosed and shielded switching power supplies

One glance at their clean, uncluttered board layouts will reassure you that the EMR's surprisingly low prices are *not* due to a compromise with quality. Those low prices *are* due to the extensive use of computer-aided design; the proprietary hybrid microcircuits which dramatically lower parts population while raising reliability; the assembling of the boards on TDK's own component insertion machines; and the fully computerized testing of all units.

If you want *more* reassurance of the EMR's high quality, touch any of their transformers, chokes, or noise filters. You'll notice that they run significantly cooler — which means they're more efficient and have more "headroom" before saturation — than the magnetics in ordinary

power supplies. One reason for their superiority is their conservative design; another is their use of TDK's own H7C1 ferrite material.

Finally, note that the EMR's on-board filters bring conducted EMI down below FCC Class B; that their all-metal perforated enclosures allow you to meet the radiated noise spec of VDE 0875/7.71 (level N) even with a plastic-enclosed product; that the EMR meet the safety specs of UL 478 and CSA C22.2-154; and that we back them with a world-wide 1-year warranty which we service locally.

The five EMR models range from a 3-output 22-Watt model for logic circuits, through a 4-output 80-Watt model with sufficient 24V power to run an 8" floppy disk drive.



Data subject to change without notice. © 1985 KEPCO, INC. Litho in USA.

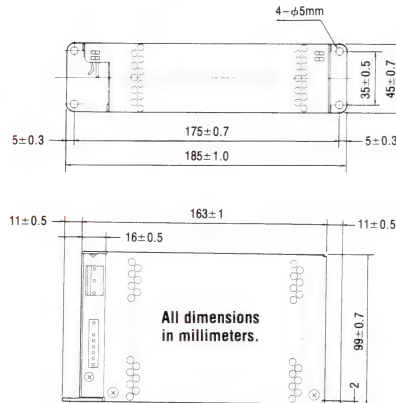
KEPCO, INC. • 131-38 SANFORD AVENUE • FLUSHING, NY 11352 USA • (718) 461-7000 • TWX #710-582-2631 • FAX: (718) 767-1102

SPECIFICATIONS		EMR 100K	EMR 200K	EMR 300K	EMR 400K	EMR 500K
Output Power		22W	42W	54W	53W	80W
D-C Output						
+ 5V (set to 5.1V)		1.0—3.0A	1.0—3.0A	2.0—6.0A	2.0—4.0A	2.0—5.0A
+12V		0.0—0.3A	0.4—2.0A	0.2—1.0A	0.1—0.5A	0.4—2.3A
-12V		0.0—0.3A	0.0—0.3A	0.2—1.0A	0.0—0.3A	0.0—0.3A
+24V		—	—	—	0.2—1.0A	0.2—1.0A
Efficiency (typ)		66%	70%	75%	75%	78%
Current Limit Setting						
+ 5V		3.1—6.0	3.1—6.0	6.3—8.4	4.2—5.9	5.2—7.0
+12V		0.5—1.2	2.2—4.0	1.1—1.6	0.5—1.0	2.5—3.5
-12V		0.5—1.2	0.5—1.2	1.1—1.6	0.5—1.2	0.5—1.2
+24V		—	—	—	1.1—2.0	1.1—2.0
Characteristic		Foldback	Foldback	Rectangular	Rectangular	Rectangular
Combined Effect, Source and Load						
+ 5V		< ±3%	< ±3%	< ±3%	< ±3%	< ±3%
+12V		< ±5%	< +7% < -4%	< +4% < -7%	< +4% < -7%	< +4% < -7%
-12V		< ±5%	< ±5%	< +4% < -7%	< ±5%	< ±5%
+24V		—	—	—	< +7% < -4%	< +4% < -7%
A-C Source Voltage		85-130V a-c or 170-260V a-c (brown out: 75V/150V)				
A-C Source Frequency		47 to 66 Hz single phase				
Source Current (typ)						
115V a-c		0.7A	1.4A	1.7A	1.7A	2.5A
230V a-c		0.4A	0.7A	0.9A	0.9A	1.3A
Fuse		1.2A	2.5A	2.5A	2.5A	3.15A
½-Cycle Peak Current (at turn-on)		45A (limited by power thermistor)				
Overvoltage Protection Setting (+5V)		5.8—6.9V (reset, turn off a-c for 50 seconds)				
Temperature Effect (0 to +50°C)		3% max.				
Drift (.5 to 8.5 hours)		0.5% max.				
Ripple envelope, source, & switching frequency, peak-to-peak	+ 5V	50mV typ. 100mV max.	50mV typ. 100mV max.	50mV typ. 100mV max.	50mV typ. 100mV max.	50mV typ. 100mV max.
	±12V	50mV typ. 200mV max.	50mV typ. 200mV max.	50mV typ. 200mV max.	50mV typ. 200mV max.	50mV typ. 200mV max.
	+24V	—	—	—	50mV typ. 200mV max.	50mV typ. 200mV max.
Spike Noise (d-c to 50 MHz)		2% E _o + 50mV max.				
Transient Recovery Time (50-100% load)		< 2 msec. (excursion < 4%)				
Holdup Time		20 msec. min., 30 msec. typ.				
EMI Conducted		Meets FCC class B.				
Safety		UL 478, CSA C22.2-154				
Materials		Case: steel; base plate: aluminum				
Operating Temperature		0-50°C; derate 50% at +70°C				
Storage Temperature		-20°C to +75°C				
Humidity		0 to 95% RH, non-condensing				
Vibration		5-10 Hz: 10mm 3 axes 10-55 Hz: 2 g 3 axes				
Shock		20 g 3 axes 11 msec ± 5 msec.				
Dimensions	Metric	99x45x163mm	99x50x199mm	114x54x223mm	129x54x223mm	129x54x253mm
	English	(3.9"x1.8"x6.4")	(3.9"x2"x7.8")	(4.5"x2.1"x8.8")	(5.1"x2.1"x8.8")	(5.1"x2.1"x10.0")
Dimensions with mounting ears	Metric	99x45x185mm	99x50x221mm	114x54x245mm	129x54x245mm	129x54x275mm
	English	(3.9"x1.8"x7.3")	(3.9"x2"x8.7")	(4.5"x2.1"x9.7")	(5.1"x2.1"x9.7")	(5.1"x2.1"x10.8")
Mounting		Four 5mm diameter mounting holes				

	Connector	Mating Housing	Terminal
INPUT	5277-04A-4	5265-04	5167
OUTPUT	5275-07A	5265-07	5167

(Manufacturer: MOLEX)

**EMR
100K**

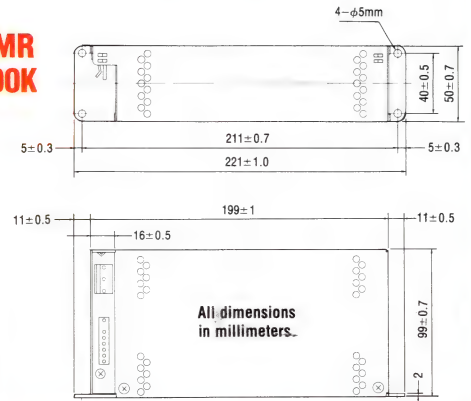


Net weight: 1.3 lbs/0.6 Kg

	Connector	Mating Housing	Terminal
INPUT	5277-04A-4	5265-04	5167
OUTPUT	5275-07A	5265-07	5167

(Manufacturer: MOLEX)

**EMR
200K**

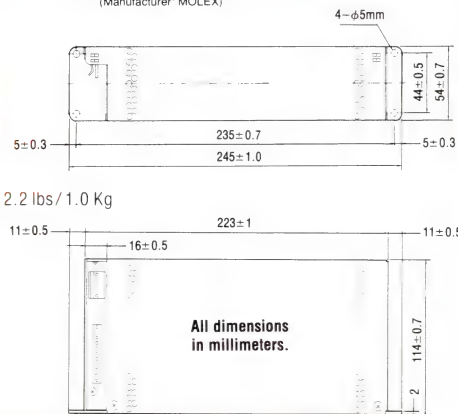


Net weight: 1.8 lbs/0.8 Kg

	Connector	Mating Housing	Terminal
INPUT	5277-04A-4	5265-04	5167
OUTPUT	5275-10A	5265-10	5167

(Manufacturer: MOLEX)

**EMR
300K**

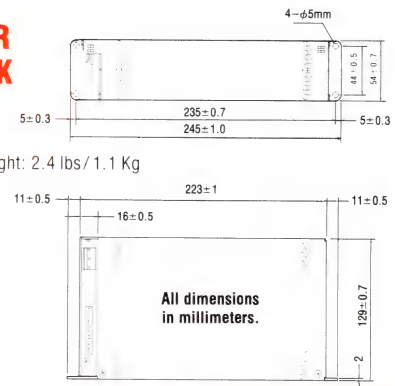


Net weight: 2.2 lbs/1.0 Kg

	Connector	Mating Housing	Terminal
INPUT	5277-04A-4	5265-04	5167
OUTPUT	5275-10A	5265-10	5167

(Manufacturer: MOLEX)

**EMR
400K**

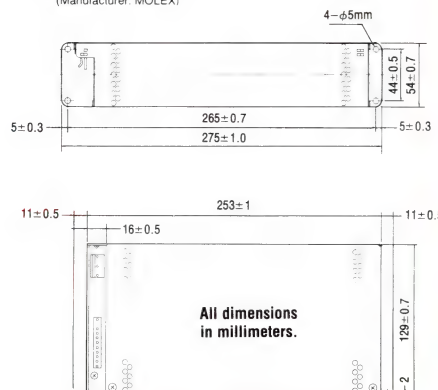


Net weight: 2.4 lbs/1.1 Kg

	Connector	Mating Housing	Terminal
INPUT	5277-04A-4	5265-04	5167
OUTPUT	5275-10A	5265-10	5167

(Manufacturer: MOLEX)

**EMR
500K**



Net weight: 3.1 lbs/1.4 Kg.

**NOTE: Equivalent English-Measure
Molex Mating Connectors are:**

	Connector	Mating Housing	Terminal
INPUT	5277-	5196-	5194/5225
OUTPUT	5275-	5196-	5194/5225

This KEPCO
product is backed
by a firm
**1-YEAR
WARRANTY**



"How do you get productivity moving?"

"Talk to Gould"

Keeping the wheels of industry turning.

Gould Industrial Automation Systems have helped to turn existing labour-intensive manufacturing operations into efficient, integrated production systems, that are flexible enough to adapt to shifting product cycles and smaller production runs.

As well as being increasingly used in the automobile industry, these Gould Industrial Automation Systems are used in electronics, food processing utility, chemicals, and aerospace.

Gould is also predominant in four other rapidly expanding markets. Information Systems, Instrument Systems, Defence Systems and Electronic Components, including semi-conductors.

To find out more about Gould's capabilities, write to:

Gould Electronics Ltd., Gould House, Viabes Industrial Estate, Basingstoke, Hampshire RG22 4LT, England.

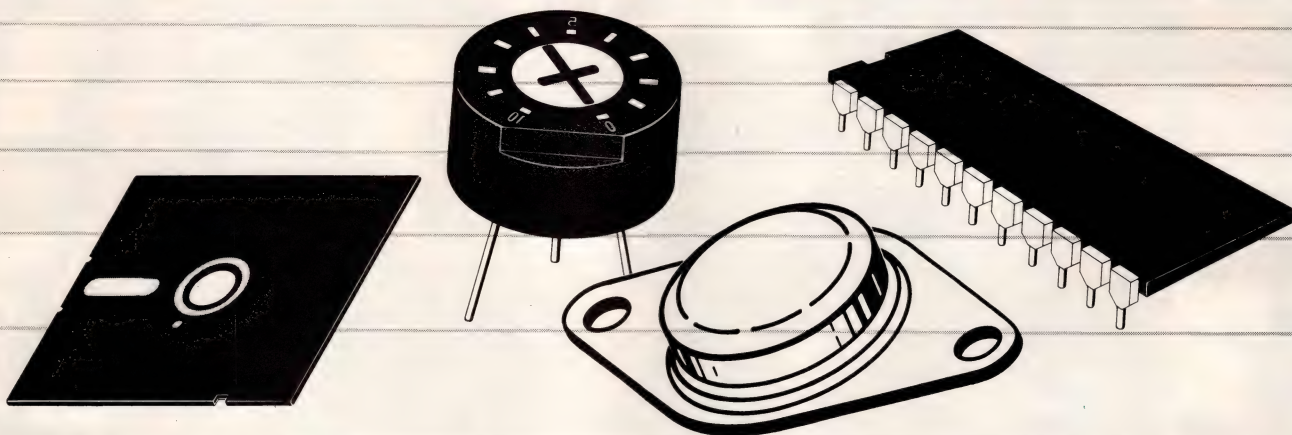


GOULD
Electronics

Circle 102 on reader service card

The industry's leading coverage of technology news.

In Electronics.



Electronics is back—with the industry's best reporting on technology. In the first half of 1985 alone, Electronics featured hundreds of important articles with news and analysis that leaders in the field can't afford to be without:

- Full coverage of computer technology, with 86 articles on computer systems, 50 on software, 33 on boards and peripherals, and 28 on CAD/CAM
- 140 articles on international technology
- 30 articles on military technology
- 27 articles on the latest developments in test and measurement equipment
- Over 100 articles on communications technology

- 40 articles on components technology
- More than 100 articles on worldwide events in semi-conductor technology.

Readers depend on us for this full scope of technology coverage worldwide. Shouldn't your selling message be in Electronics' environment of pivotal technology reporting and analysis?

Put your advertising where the electronics attention is. Call Electronics today, at 212/512-3140 (U.S.), to reserve your ad space. Outside the U.S. contact your sales representative.

Electronics is back. Shouldn't you be back as well?



STABILITY PRECISION RELIABILITY ON TARGET!

Our products:

OSCILLATORS:

from 1 Hz to 1 GHz - Clock
oscillators - TCXO'S - VCXO'S -
OCXO'S.

FILTERS:

from 10 kHz to 350 MHz
narrow or wide-band-SSB-FM.
Notch filters Discriminators.

CRYSTALS:

from 800 kHz to 200 MHz for
professional and custom design
applications.

For your applications:

- Avionics
- Space
- Radiocommunications
- Telecommunications
- Telephone Networks

We are your partner for any
project requiring high reliability
piezo electric components.

CEPE
Compagnie d'Électronique
et de Piézo-Électricité
14, avenue de la Glacière. BP 165
95105 ARGENTEUIL - Cedex/France
Tél.: (33.1) 39.82.09.45
Téléx: TCSF 204 780 F



NUMBER 1 IN
- **OSCILLATORS**
- **FILTERS**
- **CRYSTALS**

BAZAINE 5504/1

THE COMPONENTS OF SUCCESS



Belgium
THOMSON S.A.
Département Composants et Tubes
BRUXELLES
Tel.: (32.2) 648 64 85

Italy
THOMSON CSF
Composants
MILAN
Tel.: (39.2) 688 41 41
607 37 61

The Netherlands
THOMSON S.A. N.V.
RA's Gravenmoer
Tel.: (31.1673) 17 600

Spain
THOMSON CSF
Componentes y Tubos S.A.
MADRID 27
Tel.: (34.1) 405 1615

**Sweden, Finland,
Norway, Denmark**
THOMSON CSF
Komponenter & Elektronor AB
STOCKHOLM 27
Tel.: (46.8) 22 58 15

United Kingdom
THOMSON CSF
Components and Materials
BASINGSTOKE, HANTS RG24 0DG
Tel.: (44.256) 29155

USA
FIS
Beverly Mass. 01915
Tel.: (617) 927.8220

West-Germany
THOMSON CSF
Bauelemente GmbH
MUNICH 70
Tel.: (49.89) 78 790

Circle 103 on reader service card

Cellular Radio, Radio Voice and Data ...



... the complete measuring solution

Selective calling, radio data and cellular radio – those are the headlines in modern two-way radio measurements. And Rohde & Schwarz has the right solution in every case.

SMFS 2/SMFP 2 better than ever
Improved spectral purity, internal two-tone modulation, new options for adjacent-channel power and full-duplex working, nonvolatile memory – just a few of the new features that make the SMFS 2/SMFP 2 family the optimal measuring solution in every application from a manual repair bench through to an ATE in the production of high-speed radio-data units.

Radiocode Test Set SCUD

Flexible and thorough in measurement down to the smallest detail – the SCUD generates and analyzes selective-call signal sequences of any standard and handles all common radio-data modes such as FSK, FFSK, PSK and DPSK.

There are software packages available for **future-oriented cellular-radio-systems** like NMT, AMPS and TACS. The SCUD offers in addition all the control functions of the Process Controller PUC.

In short: an indispensable tool for the development and trial of new radio systems, but no less essential for a versatile service shop and all-round production testing.

Rohde & Schwarz GmbH & Co. KG
Postfach 80 14 69
D-8000 Muenchen 80
Federal Republic of Germany
Telex 523 703 (rus d)
Tel. internat. + (49 89) 41 29-0

There are **R & S agencies** in 80 countries. We plan and supply stationary and mobile systems, also on a turn-key basis.
R & S services comprise installation, maintenance, calibration, training and documentation.

Circle 104 on reader service card



ROHDE & SCHWARZ

Measuring Instruments and Systems · Sound and TV Broadcasting
Radiomonitoring and Radiolocation · Radiocommunications

FLEXIBLE INSPECTION: THE HOT TOPIC AT CHERRY HILL

TEST MEETING TO DISCUSS AUTOMATIC VISION, THERMOGRAPH, LASERS

Innovation in chip and circuit-board testing is still flourishing, despite the present industry slump. "A recession can be a powerful blessing in disguise—it's a terrific time to rethink what is established, to challenge what is assumed," says Scott T. Jones, vice president of marketing for Control Automation Inc., a Princeton, N. J., test-equipment maker. Next week's Cherry Hill conference, which will spotlight the latest test equipment wending its way to the factory floor, will prove out Jones's statement.

One of the hottest topics at the Philadelphia gathering, now known as the International Test Conference, will be the flexible inspection system. It can switch instantly between testing tasks and compare a board under test with the stored image of a known-good board. Such systems bring higher reliability and greater speed to board inspection through their use of computer-based equipment that applies solid-state video cameras and decision algorithms to the procedure. Jones of Control Automation will give attending engineers an overview of the types of flexible inspection systems available for pc-board production.

One such flexible system, automatic vision testing, outperforms human visual, in-circuit, and functional board testing in spotting presolder defects. Another type of flexible system, the thermograph, identifies such faults as shorts by temperature readings. Designers are also using electron beams and lasers in testing memory and microprocessor chips.

Studies done by equipment manufacturers show that 45% of manufacturing defects occur in bare-board production, 25% in assembly, and the rest during soldering. The increase in pc-board density has led to more tiny surface-mounted components whose solder contacts are invisible to the eye. As board traces shrink from 12-mil spacing to 5- and 3-mil geometries, defects such as pattern shorts, opens, cracks, pinholes, and nicks show up more often and are difficult to detect visually. Manual inspection of bare boards with closely spaced traces is tedious and relatively ineffective. Checking loaded boards manually is also ineffective, locating less than 50% of bent or missing component leads. Surface-mounted components cannot be inspected visually.

Flexible inspection systems handle different assignments at the touch of a button. They are programmed to inspect for defects in bare-board, loaded-board, and soldered-board production by comparing each board with a known-good board (Fig. 1). Bare-board and loaded-board flexible inspection systems come from such companies as Cognex, Control Automation, DIT-MCO International, Everett-Charles Test Systems, Itek Optical Systems, and Testerion.

But the flexible inspection systems introduced so far are costly, selling for \$150,000 to \$400,000, notes Jones of Control Automation. Also, wide variations in color and finish of the boards and conduc-

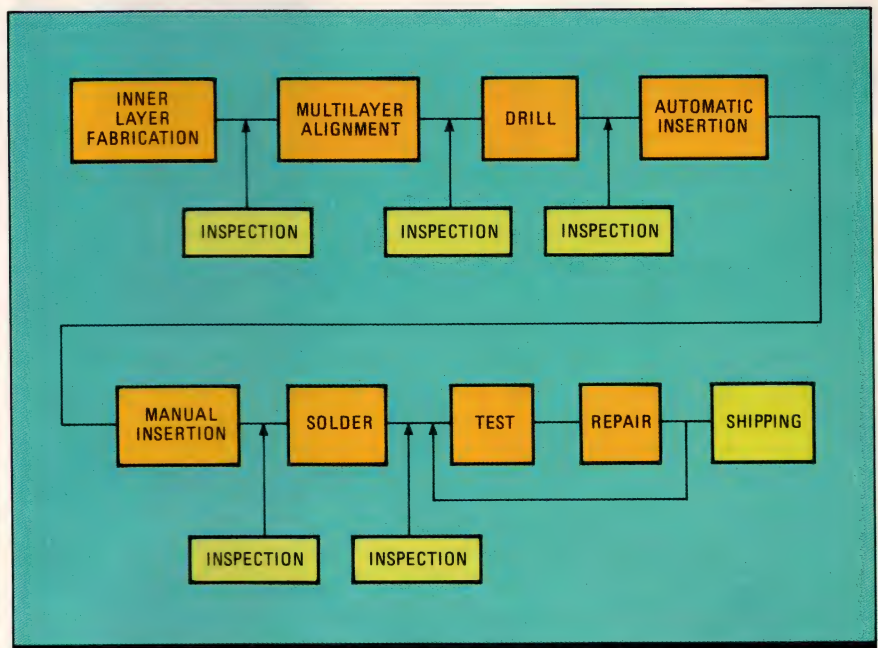
tor metals, along with the differences in customers' layouts, make a flexible system less effective.

To counter these drawbacks, equipment vendors are applying software-based image enhancement, optical filtering, and advanced illumination techniques. Semiautomatic X-ray-based systems that check inner-layer pattern alignment of multilayer boards are now available, along with bare-board pattern-inspection systems to verify the presence of via and drilled through-holes, Jones says. Among the companies pursuing X-ray solutions are IRT, San Diego, Calif., and Nicolet Instruments, Madison, Wis.

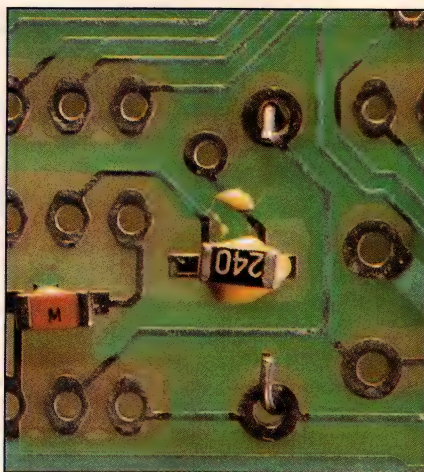
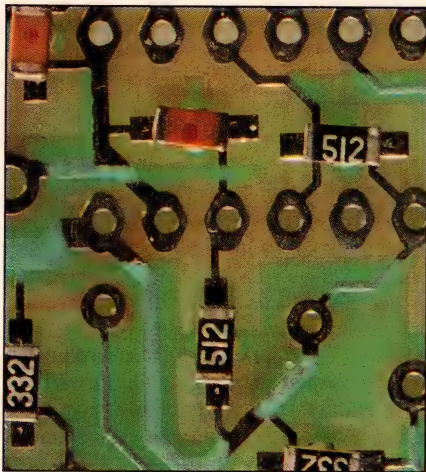
For loaded boards, the most insidious but common defect is the incorrect insertion of component leads: leads bent under the component, leads sheared off during production, and leads inserted into the wrong holes. Thus the board's bottom side must be inspected before soldering. After soldering, bottom-side inspection is required to locate such manufacturing defects as solder shorts, random splatter, solder balls, and cold joints. To spot these faults—some as small as 1 mil—manufacturers are using technology ranging from ambient light to infrared emission and holographic analysis.

Automatic vision testing (AVT) can detect more than 99% of visible assembly errors on pc boards, says Don Marro, electronics manager at Cognex Corp., Needham, Mass. An automatic-vision-testing system captures an image of the board under test with a video camera. Then it transmits the video signal to a computer, which searches the image to locate visible portions of the board for comparison with those of a known-good board stored in its memory. If all components match the ideal image, the board passes the test.

Though AVT cannot test for electrical shorts, faulty parts, or board performance, it can more effectively spot a wide



1. VERSATILE. Flexible inspection systems, such as thermal, visual, and X-ray, can be installed at various stages in a high-volume production line.



2. CANDID CAMERA. Automatic-visual-inspection systems can spot topside-down components (left) and excess solder adhesive (right) on tightly packed printed-circuit boards.

variety of presolder assembly defects than can human visual testing, in-circuit testing, and functional board testing. As boards become tightly packed with surface-mounted devices, which are extremely difficult to remove and replace after the solder step, AVT becomes a more attractive inspection technique before soldering.

AVT systems can identify components that are missing, defective, or topside-down (Fig. 2a), Marro says. These systems can also point out chipped components and excess solder adhesive (Fig. 2b). They can verify component placement in relation to board solder pads and check proper component-to-component placement, he adds.

Cognex and the Delco Electronics Division of General Motors Corp. in Kokomo, Ind., conducted experiments to prove AVT's effectiveness on a variety of circuit boards. The results showed greater accuracy during inspection if components are placed in relation to solder pads rather than to a tooling hole. The system detects excess adhesive on solder pads, which degrades solderability. It measures adjacent components with 2-mil precision. It identifies a damaged component if more than 20% of the body has been broken off. Because AVT can

pinpoint many assembly defects before soldering, pairing it with a bare-board tester eliminates the need for more costly in-circuit and functional board testers.

To solve power problems, circuit designers and reliability engineers are turning to comprehensive thermal specifications and thermographic testing, says Herb Boulton, chief engineer at UTI Instruments Co., Sunnyvale, Calif. Boulton addresses this issue in his paper, "Using thermography for testing pc boards."

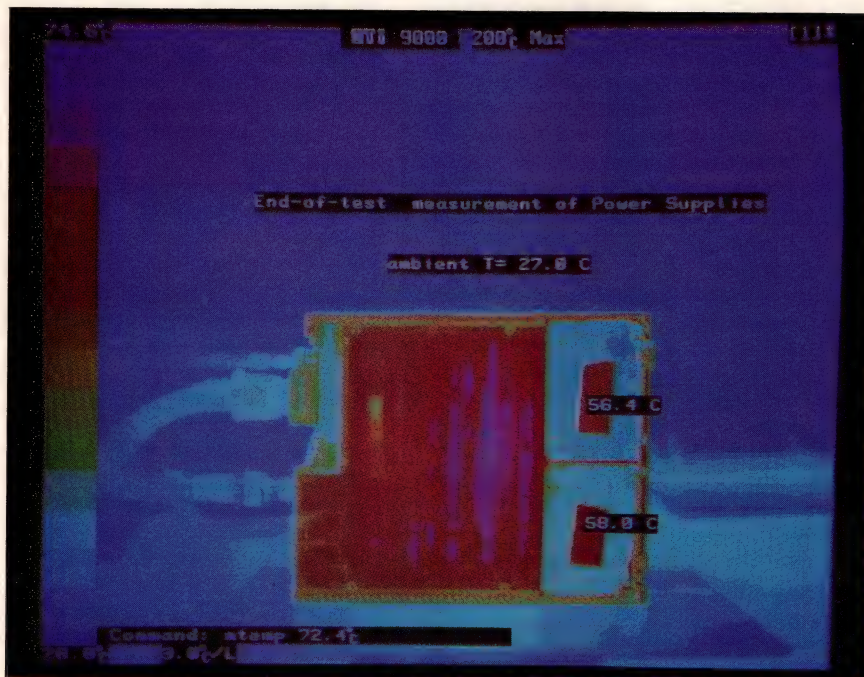
Today's packed pc boards and very large-scale-integration chips make conventional thermocouples and probes impractical. Replacing them is the thermograph, an optical-imaging system that measures and displays the temperature of an object placed within its viewing area. The display of the thermograph is similar to a picture produced by a video camera, except that the image is an analysis of the IR spectrum rather than of the visible spectrum, Boulton explains. The images produced are twice as sharp as commercial TV pictures because thermal imagers resolve twice as many pixels for each scanning line.

The test begins when a work-station operator loads the board under test into its holding fixture. After applying power and signal inputs, the operator gives the board several minutes to reach its normal operating temperature. The thermograph then scans the board and displays the temperature information to identify such faults as shorts or low-resistance paths (Fig. 3). Then the system compares this thermogram with that of a known-good board stored in memory. Differences between the two are displayed, and the operator can pinpoint out-of-tolerance conditions caused by ICs that are faulty or inserted incorrectly.

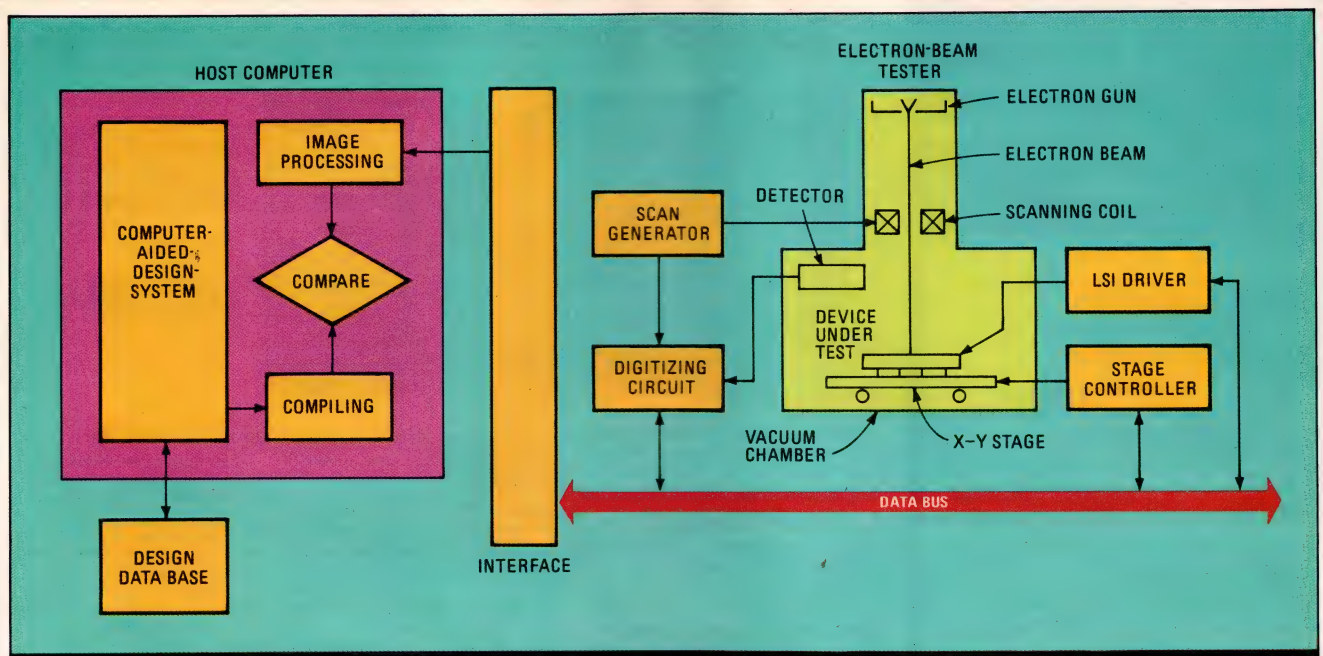
By combining a thermal test chamber including a viewing window with a thermograph, complete thermal profiles of a pc board can be generated. A closed-loop airflow between the thermal chamber and an adjacent heat exchanger produces a wide range of temperatures.

Testing modern VLSI chips is even knottier than board testing. Atsugi Electrical Communications Laboratories, Kanagawa, Japan, has developed an electron-beam tester linked with a computer-aided-design system for diagnostic testing of VLSI chips. The Finder (fault-identification system for LSI circuits with a non-conducting data-base-oriented electron-beam tester) automatically prepares a logic-state map of the device under test to check the internal behavior of the individual circuits (Fig. 4). The tester verifies logic states on the metal-wire pattern that is on the chip's surface.

For every wire pattern on the chip's surface, a logic value is measured for comparison with the expected value derived from logic simulation. The electron-beam tester creates a logic-state map of the device under test that has all the top-surface metal-wire patterns displayed in different colors according to expected logical values. To prepare the logic-state map, each interconnection pattern at the mask-pattern level is linked to a circuit node on the logic-circuit diagram. A set of connecting lines linked to the same node



3. HOT SPOTS. Thermographs, such as those of a power supply, identify board defects by comparing the thermal image of a known-good board with the board under test.



4. FINDER. Atsugi's electron-beam tester analyzes the internal operations of individual circuits in a very-large-scale-integration chip.

is called a net. By using assigned net numbers, the tester correlates actual metal-wire patterns on a chip to nodes on the circuit diagram. The tester assigns metal-wire patterns to simulated results.

With Finder, the device under test is mounted on its X-Y fixture in the electron-beam vacuum chamber with test patterns applied through an LSI driver stage. The electron-beam tester, with a scanning area of $500 \mu\text{m}^2$, develops an image from the top-surface wires of the device under test that are at low-voltage or logical-zero levels while under test. The voltage-contrast image signals are digitized and transferred to the host computer.

But when electron-beam testing takes place without a conventional LSI tester, inspection takes too long, which also is a problem in laser probing. To test an LSI chip, logic-state maps are prepared over the entire chip surface for a large number of test patterns and then matched against the logic states predicted from the CAD-design data base. A 10-mm^2 chip, for example, involves 400 observation areas. To cut test time, an operator must localize the chip defect with a conventional LSI tester before final diagnosis by the electron-beam tester.

LASER PROBING

Logic-mode and image-mode analysis are two laser probing techniques for testing VLSI parts without contact. With logic-mode analysis, the logic state at the point of laser irradiation is checked; image-mode analysis provides a contrast image of photo-induced current produced when a laser scans the surface of a VLSI part in two dimensions. Both probing techniques can be performed in a normal environment—a distinct advantage over electron-beam probing techniques, which must take place in a vacuum.

An on-line laser-probing system combining both techniques has been developed at Matsushita's Semiconductor Research Center in Osaka, Japan, to locate and diagnose faults in VLSI parts. The source, a helium-neon laser, has a wavelength of 632.8 nm . An acoustic-optic modulator controls its output power and pulse level. The power of the object lens on the microscope determines the diameter of the laser beam focused on the surface of the device under test. Using an X-Y mirror and mirror-drive circuitry, the operator can focus the laser beam precisely at any point on the surface of the device under test.

The status and performance of the device under test is

analyzed by laser irradiation producing photo-induced current, which is detected and amplified in the photo-induced-current-detector stage and then stored in memory. Power and test stimuli are applied to the device under test through a logic tester, which also monitors output signal status. During logic-mode analysis, data stored in the photo-induced-current memory gives a display of the logic state at the point of laser irradiation. In the image-analysis mode, a contrast image of the area scanned by the laser beam comes from data stored in the photo-induced-current memory.

During fault diagnosis using image-mode analysis, contrast in the photo-induced-current image of a good device is compared with that of a faulty device under test. Because of the large number of images obtained from the extensive test-pattern sequence applied, it is difficult to judge which section of the device under test is defective.

To pinpoint the malfunction, the Matsushita design displays the photo-induced-current image of a good device in green on the color monitor; the photo-induced-current image of the device under test appears in red. The areas that are functionally identical and thus good will appear yellow when the images are superimposed. The section that is malfunctioning will appear in red or green, depending on the image-contrast level.

For logic-mode analysis, the system probes nodes that seem to be propagating signal errors. It compares the output data with the simulation data from the device-design data base. With the logic-mode probing technique and special software created for Matsushita's on-line system, the operator can detect gate propagation and gate faults automatically.

The drawback to Matsushita's prototype system is the lengthy time to diagnose faults during image-mode analysis. About eight hours are needed to diagnose a fault in a 10-mm^2 chip using a 100-step test pattern and $10\times$ objective lens. The system's $10\times$ lens has a visual field of only $1.8 \mu\text{m}$, requiring subdivision of a large VLSI chip's surface into several areas for multiple laser scans. To cut diagnostic time, Matsushita is developing optical lenses with wider fields.

The goal of product manufacturing is a zero-defect process—no rejects coming off the line. But as designer engineers continue to pack printed-circuit boards and chips more tightly, test-equipment engineers may find that goal even farther off. □

CSEM

(the Swiss Center for Electronics and Microtechnology Inc.)

performs R & D work and small quantity production of components and systems for industry and government agencies

CMOS CIRCUITS

Design and small-scale fabrication of custom digital and analog IC's for

- Battery operated electronics
- Micropower telecom
- Monolithic light detectors
- Switched capacitor IC's
- Non-volatile EEPROM

MASK-MAKING

Optical and electron-beam 1 x, 5 x, 10 x chromium masks, multi-project masks

SENSOR R & D

Small-scale fabrication of customized sensors for

- Pressure and acceleration
- Magnetic fields
- Ionizing radiation
- Chemical activity and gases
- Thermal flow

based on silicon, fiber-optic or thin film technologies

PIEZOELECTRIC DEVICES

FAILURE ANALYSIS

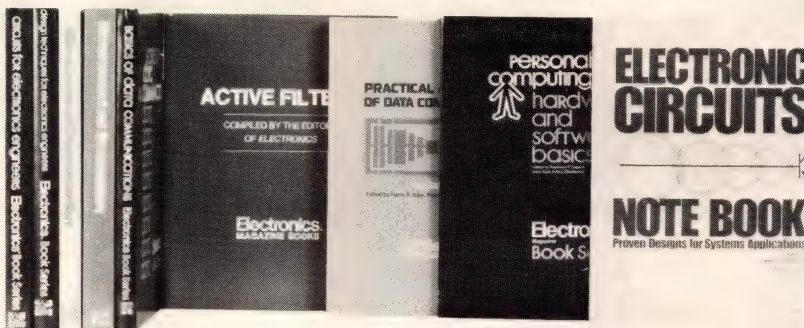
of electronic devices

OPTICAL DEVICES

- Interferometric cells
- Solid-state microshutters
- Solid-state displays
- Monomode fiber components
- Computer-generated holograms

Published by Electronics Magazine...

Books of special interest to our readers



Circuits for Electronics Engineers

Almost 350 diagrammed circuits arranged by 51 of the most useful functions for designers. Taken from the popular "Designer's Casebook" of *Electronics*, these circuits have been designed by engineers for the achievement of specific engineering objectives. Pub. 1977, 396 pages, softcover. Order No. R-711, \$17.95.

Electronic Circuits Notebook

Contains 268 completely illustrated electronic circuits conveniently arranged by 39 vital functions, including amplifiers, audio circuits, control circuits, detectors, converters, display circuits, power supplies and voltage regulators, function generators, memory circuits, microprocessors, and many others, as published in *Electronics* magazine 1977-1980. Companion volume to *Circuits for Electronics Engineers*. Pub. 1981, 344 pages, softcover. Order No. R-026, \$17.95.

Design Techniques for Electronics Engineers

Expert guidance at every point in the development of an engineering project—making measurements, interpreting data, making calculations, choosing materials, controlling environment, laying out and purchasing components, and interconnecting them swiftly and accurately. Nearly 300 articles from *Electronics*' "Engineer's Notebook," with more than 500 diagrams and tables. Pub. 1977, 370 pages, softcover. Order No. R-726, \$17.95.

Microelectronics Interconnection and Packaging

Articles from *Electronics* include sections on lithography and processing for integrated circuits, thick- and thin-film hybrids, printed-circuit-board technology, automatic wiring technology, IC packages and connectors, environmental factors affecting interconnections and packages, computer-aided design, and automatic testing. Pub. 1980, 321 pages, softcover. Order No. R-927, \$15.95.

Microprocessors and Microcomputers:

One-chip Controllers to High-end Systems

Practical orientation to all aspects of microprocessors and microcomputers in 95 articles from *Electronics* covering low-end microcontrollers, mid-range microprocessors, high-performance 16-bit microprocessors, high-speed bipolar processors, peripheral support chips, signal processors, board-level microcomputers, software and applications. Pub. 1980, 482 pages, softcover. Order No. R-011, \$18.95.

Basics of Data Communications

This compilation of essential articles from *Data Communications* magazine includes chapters on terminals, acoustic couplers and modems, communications processors, networking, channel performance, data link controls, network diagnostics, interfaces, and regulations and policy. Pub. 1976, 303 pages, softcover. Order No. R-608, \$15.95.

Practical Applications of Data Communications

Selected articles from *Data Communications* magazine cover architecture and protocols, data-link performance, distributed data processing, software, data security, testing and diagnostics, communications processors, and digitized-voice and data-plus-voice. Pub. 1980, 424 pages, softcover. Order No. R-005, \$17.95.

Personal Computing: Hardware and Software Basics

More than 50 articles from leading publications provide information on personal computing hardware, software, theory and applications. Pub. 1979, 266 pages, softcover. Order No. R-903, \$15.95.

Active Filters

Covers the theory and practical implementation of filter networks built with active elements. Includes design tables and computer/calculator programs, as published in *Electronics*. Pub. 1980, 133 pages, softcover. Order No. R-003, \$11.95.

Order today using this coupon!

Electronics Magazine Books

P.O. Box 541
Hightstown, NJ 08520
609/426-5070

McGraw-Hill Intl. Publications Co.
European Circulation Center
Maidenhead, Berks. SL6 2QL, UK
(Tel. 0628) 23431; Telex 848640)

Order #	Qty	Price
R-		\$
R-		\$
R-		\$
R-		\$
R-		\$

Name _____

Title _____

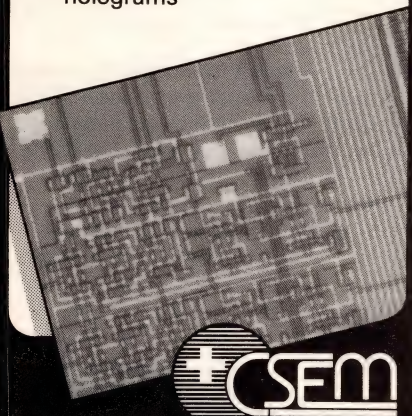
Company _____

Street/PO address _____

City/State/Zip (Outside USA: City/postal code/country) _____

☐ Payment enclosed (Payment must accompany orders under \$25. USA residents add applicable local tax.)
☐ Bill my company (or attach company Purchase Order)
☐ Bill me

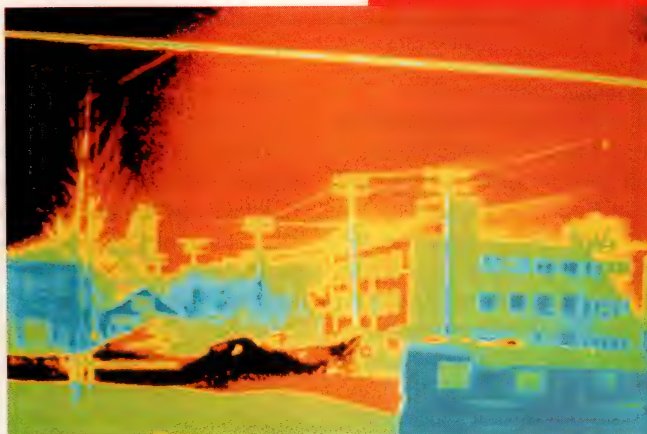
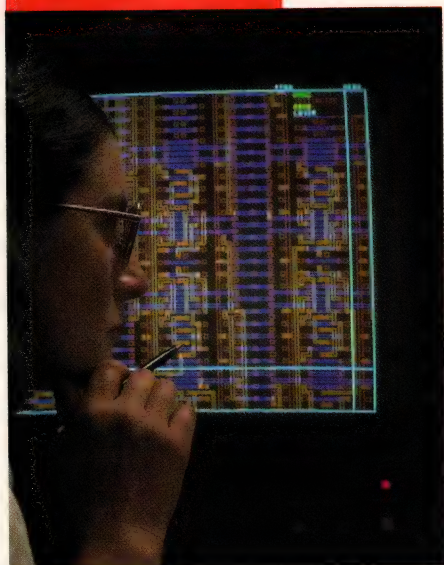
Ten-day money-back guarantee applies on all books



CENTRE SUISSE D'ELECTRONIQUE
ET DE MICROTECHNIQUE S.A.
Maladière 71 - CH-2000 NEUCHÂTEL 7
Phone 038 24 01 61 - Telex 952 664

CANADA

SPECIAL ADVERTISING SECTION



CANADA'S ELECTRONIC MARKET PASSES \$12 BILLION MARK



Manufactures offer diversified product
lines to capture world market

The Canadian demand for electronic products rose a healthy 28% from \$9 billion in 1983 to almost \$12 billion in 1984, according to a recent survey by Canada's Department of Regional Industrial Expansion. The growth in Canada's apparent domestic market, which is the sum of Canadian production and imports less exports, peaked early in 1984 and coasted on its momentum to end the year with a respectable growth rate of 17%. Office machine suppliers and radio and television manufacturers lead the industry posting an impressive growth rate of 46% and 33% respectively over 1983. The increased demands in the domestic market were satisfied by major manufacturers from the U.S., UK and Japan. The Canadian electronic industry imported \$10.5 billion in 1984, a 42% surge above 1983. The annual

growth rate for exports was 41%, about the same level as imports.

According to Canada's Electronic Industry Performance Statistical Summary, by the end of 1984 the market rise of \$2.6 billion was less than the increase of imports which rose by \$3 billion. Therefore, by the end of 1984, Canadian producers had achieved a modest 14% share of the domestic market. On the brighter side, Canadian manufactures enjoyed a 42% jump in exports from \$3.6 billion to just over \$5 billion in 1984. The driving force behind this surge was the communications and component sector which rose from \$2.7 billion in 1983 to \$3.2 billion in 1984. Overall, the trend for Canadian electronics manufacturers appears quite optimistic with 1985 promising much greater growth potential in telecommunications.

Office equipment Office equipment manufacturers lead the Canadian industry with a 46% growth rate in the domestic market, from \$3.3 billion in 1983 to \$4.8 billion in 1984. The computer sector exploded, jumping 48% from \$2.9 billion in 1983 to \$4.3 billion in 1984. The demand for office

Cover photo, bottom left: The Ontario Center for Microelectronics provides a semicustom chip design service as well as seminars to offer hands-on experience with such circuit designs. Bottom right: Coreco Inc. supplies a complete line of computer vision products for use with IBM personal computers. Upper right: Printed-circuit boards for Mitel's SX-2000 contain peripheral interfaces to support on-premise telephones and data terminals.

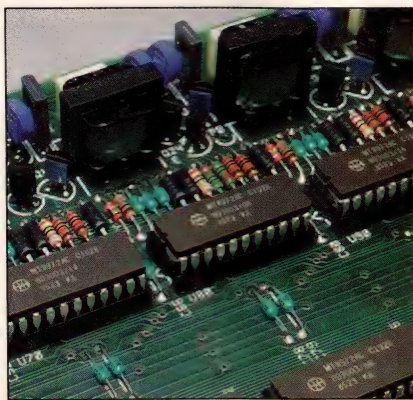
MITEL SEMICONDUCTOR

ISDN

COMPONENT NEWS

Vol. 1

ISDN Means "In Silicon, Deliverable Now" At Mitel



DNICs on typical line card.

While other semiconductor manufacturers debate the meaning of ISDN, Mitel Semiconductor is marketing its MT8972 Digital Network Interface Circuit (DNIC); a complete "U" interface conforming to the CCITT specification for the ISDN.

The MT8972 DNIC delivers the required 144 kb/s in a 2B+D channel format (*Basic Rate Access*) over existing twisted copper pair wiring. Moreover, the DNIC alone successfully incorporates the Echo Cancellation Hybrid (ECH) technique recommended by T1/D1.3 committee. ECH allows full duplex 144 kb/s operation over a single twisted copper pair, while compensating for any impedance variations along the loop.

Loop lengths vary with data rates: up to 4 km at 80 kb/s; or up to 3 km at 160 kb/s over one 24 AWG twisted-pair. At 160 kb/s

the DNIC supports: two 64 kb/s "B" channels for PCM encoded voice and/or data; one 16 kb/s "D" channel for signaling and low-speed packet-switched data; plus one 16 kb/s channel that conveys loop framing and housekeeping information. At 80 kb/s, the DNIC offers one B channel, an 8 kb/s D channel, plus a housekeeping and framing channel.

Clock and frame extraction can be derived from the line or generated by internal circuitry. ISO-CMOS fabrication minimizes power consumption to 50 mW (typical) permitting the network

interface to be line-powered. The MT8972 DNIC also can be used as a 160 kb/s high-speed, limited-distance modem. Its Serial Telecommunications Bus (*ST-BUS™*) architecture simplifies intercomponent, interprocessor and multiprocessor communications on-board, on-premises or at the network interface.

Other ISDN support circuits now available from Mitel are:

- T1/DS-1 and CEPT trunk interfaces (MT8975, MT8978).
- Digital Crosspoint Switch ICs (MT8980/81).
- T1/CEPT Digital Trunk Phase Locked Loop ICs (MT8940).
- PCM Filter/Codec ICs (MT8960).
- HDLC Controller ICs (MT8952).

While others joke that ISDN means "I Still Don't Know", Mitel Semiconductor is producing silicon that makes ISDN happen.



MITEL SEMICONDUCTOR

UNITED STATES – San Diego, California. Telephone: (619) 276-3421. San Jose, California. Telephone: (408) 249-2111. Oakbrook, Illinois. Telephone: (312) 655-3930. Boca Raton, Florida. Telephone: (305) 994-8500. **CANADA** – Kanata, Ontario. Telephone: (613) 592-5630. **UNITED KINGDOM** – Portskewett, Newport, Gwent, South Wales NP6 4YR. Telephone: +44 291-423355. **ASIA** – Tsuen Wan, Hong Kong. Telephone: +852 0-463641. **EUROPE** – Denmark. Telephone: +45 1-612566. Milan, Italy. Telephone: +39 2-8245222/8245177. West Germany. Telephone: +49 711-7701522.

TM, ® – Trademark of Mitel Corporation
© Copyright 1985 Mitel Corporation

Circle 63 on reader service card

machine products required Canada to import \$4.9 billion, a 40% rise over 1983. Canada's two major importers were the U.S. and Japan with imports of \$4.06 billion and \$258 million respectively. The Canadian computer products sector exported a respectable \$1.33 billion, mainly to U.S. and UK customers.

Electronics components In 1984 Canada was both a heavy exporter and importer of printed circuit boards. Total PCB imports for 1984 was \$45.5 million, a 24% jump from 1983, with 35.8 million going to American distributors and \$7.5 million shipped from Far East suppliers. On the flip-side, Canadian PCB manufacturers supplied customers from the U.S. and UK with complex double-sided and multi-layered boards to the tune of \$39.9 million in 1984. Imports of resistors reached \$34.9 million, and \$83 million for capacitors.

Instrumentation The domestic market for test instruments jumped 14%

from just over \$1.4 billion in 1983 to \$1.6 billion in 1984. Canadian manufacturers imported a total of \$358 million for instruments. Electrical measurement equipment represented the major portion of electrical instrument imports by Canada at just under \$150 million. The U.S. lead other foreign instrument importers by providing Canada with \$135 million worth of imports. Electronic instrument exports rose to \$20.4 million, up a healthy 15% from 1984.

Telecommunications

Telecommunications was a \$1.9 billion industry for Canada with a robust 19% leap in 1984 over 1983. The commercial equipment sector outperformed all other telecommunication sectors with imports of \$292 million and exports of \$400 million. Canadian manufacturers exported more telecommunication equipment than any other sector at \$1.65 billion with more than 60% of the equipment exported to US customers. Canada imported \$238 million worth of telephone equipment with \$162 million

from the U.S. and \$32 million from Japan. On the whole, the Canadian telecommunication industry scored impressive growth in both exports and imports.

Consumer electronics The consumer electronics market rose from over \$1.2 billion in 1983 to almost \$1.5 billion in 1984. Leading the radio and television sector was portable tape players with 1984 imports at \$564 million; as might be expected, Japan provided 87% of Canada's demand for these products. Color televisions over 19-inch screen size were in great demand, with Canada importing \$157 million in 1984, split between U.S., Japan and Taiwan. Microwave oven and auto radio imports were up 55% and 10.2% respectively. Canadian manufacturers exported \$105 million in radio/phono players to the US market. Also, a respectable \$49 million worth of 19-inch color TV sets were exported during 1984, with the majority of units shipped to the United States.

TABLE 1. 1984 SUMMARY OF CANADIAN IMPORTS
(dollars in millions)

Products	Total	US	Japan	Taiwan	Others
Office Equipment					
Computers	4242	3890	11.4	3.9	336.7
Electric Typewriters	41	12	18	10.5	0.5
Telecommunications					
Commercial Equipment	292	184	67	5	36
Telephones	238	162	32	10.7	32.3
Navigation Equipment	71.7	63	3.5	0.2	5
Radio Trans/RCV	48.7	32.3	7.7	2.6	6.1
Radio/TV Broadcasting	48.3	30.2	13.7	0.1	4.3
Radar Equipment	33.3	28.3	1.3		3.7
Components					
Semiconductors and Parts	763	738	4.4	1.6	19
Integrated Circuits	466	382	9	15	60
Tubes	125	85	20	10	10
Printed Circuit Boards	45.5	35.5	1.2	5.8	3
Resistors	34.9	26.7	1.8	1.7	4.7
Television and Radio					
Radio/Phonograph	288	71.2	93.1	31.2	92.5
Color Television over 19"	157	77.1	38.5	7.8	33.6



"DY-4 provided a unique VME solution for a sophisticated de Havilland application" — Buster Honegger, Ursel & Associates, Ottawa

Expertly Crafted VME System Solutions

Demanding design specifications for the flight management computer system used in a de Havilland DASH-7 ice reconnaissance aircraft led us to consider DY-4's VMEbus product line.

Requirements for high reliability in a hostile environment and an architecture supporting multiprocessing and intelligent I/O were met by configuring a system with DY-4's: DVME-102 68000 based single board computer, DVME-201 octal serial I/O card, DVME-680 analog I/O controller, DVME-503 universal memory card, and multiple DVME-705 intelligent dual channel ARINC 429 cards.

DY-4's extensive systems design experience has enabled them to achieve high functionality without stacking IC's on the PCB, thus increasing reliability and serviceability. Cabling problems associated with other vendors' front panel I/O implementation has been avoided by providing all I/O via the P2 connector.

In addition, our QA Vendor Audit of the company revealed extensive Quality Control procedures and configuration control methodology supported by excellent Production documentation.

The result was a system which successfully completed our Design Approval Testing for temperature, EMI, vibration and

shock. We will definitely be going back to DY-4 for the second generation system!

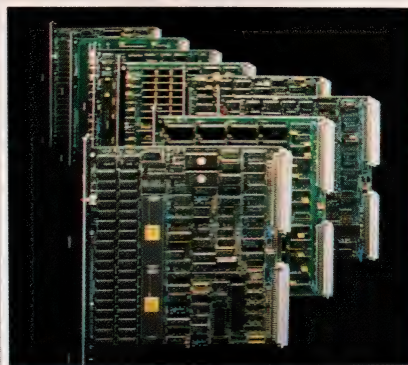
DY-4's VME series currently includes:

160 mm. Processor Cards.

- SVME-101** — Intelligent VMEbus Expansion Card.
- SVME-103** — 68010 CPU, I/O, 1/2 MB DRAM
- SVME-109** — System Processor with 4 channel I/O
- SVME-132** — 68020 CPU, I/O, 1MB DRAM, Floating Point

220 mm Processor Cards

- DVME-102** — CPU with 1MB DRAM, I/O, MMU
- DVME-104** — 68010 CPU, I/O, 1MB DRAM
- DVME-105** — CPU with I/O, 14 bytewides.



DY-4 SYSTEMS INC.

DY-4 SYSTEMS INC.
175 S. Bascom Ave., Campbell, CA 95008 (408) 377-9822

DY-4 SYSTEMS INC.
888 Lady Ellen Place, Ottawa, Ontario, Canada K1Z 5M1 (613) 728-3711

DY-4 SYSTEMS INC.
Solbakken 48, DK-8450, Hammel, Denmark (06) 96-3624 TLX 60938 (Dendy DK)
Circle 65 on reader service card

CHIPS AND PHONES

Long recognized as a leading supplier of compatible communications systems and leading-edge semiconductors serving a worldwide market, Mitel Corporation strongly believes in the need for strategic investment in technology. That's why research and development programs are judiciously allocated close to 14 percent of revenues, compared to less than 10 percent average in the industry. Among the results achieved by the R and D effort this past year was the introduction of two sophisticated telecommunications products, the SX-2000 and SX-200/Generic 1000, which expand the existing Mitel product line to now address 90% of the PABX (private automatic branch exchange) market around the world.

Aggressive and innovative engineering and marketing strategy are responsible from Mitel's ability to manufacture and sell more PABX systems worldwide than any other manufacturer despite widely different

global standards; more than 80 countries depend on Mitel equipment to handle their voice and data communications. Although the bulk of today's world's communications facilities are analog to handle voice service, a major shift to integrate voice/data is underway. The SX-2000 Integrated Communications System, Mitel's answer to this pressing need, is an advanced digital PABX with the system architecture, software and hardware to support up to 4000 lines in large business offices.

Mitel's new SX-200/Generic 1000 digital switching system is not only a significant new product, but offers a viable opportunity for owners of Mitel's well-established SX-200 business telephone system to upgrade their facilities. The new system will support up to 128 Superset telephones and provides 480 ports; up to 24 separate businesses can be handled by the digital SX-200, Mitel claims. By establishing its subsidiary Trillium Telephone Systems Inc. during fiscal

1984, Mitel is now an active participant in the \$1 billion world market for electronic telephones and telephone switching systems dedicated to residential and small business service.

Mitel's Semiconductor Division plays a vital role in the company's technological and sales gains. With sales growth in fiscal 1985 greater than 50 percent, the Division has gained an enviable reputation within the communications industry. A major emphasis of the division this year, according to Doug Smeaton, vp and general manager, is aimed at delivering components for the newly-emerging international standard Integrated Service Digital Network (ISDN).

While some semiconductor firms sit on the sidelines and jokingly refer to ISDN as "I Still Don't Know", Mitel Semiconductor is actively developing state-of-the-art silicon chips to establish a strong position in this potentially huge, worldwide market. The first commercially available integrated circuit to address the ISDN

TABLE 2. 1984 SUMMARY OF CANADIAN EXPORTS
(dollars in millions)

Products	Total	US	UK	Others
Office Equipment				
Computers	1328.3	1014	61.3	253
Electric Typewriters	32.6	32.3		0.3
Telecommunications				
Commercial Equipment	400	202	12.4	185.6
Telephones	820	522	42	256
Navigation Equipment	203	156	10.5	36.5
Radio Trans/RCV	179	123	5.4	50.6
Radio/TV Broadcasting	17.8	10.8	1.6	5.4
Radar Equipment	26.6	16.5	0.2	9.9
Components				
Semiconductors and Parts	565	497.3	4.3	63.4
Integrated Circuits	233	180	7.2	45.8
Tubes	30	21	2.9	6.1
Printed Circuit Boards	39.9	32.7	5.7	1.5
Resistors	4.9	4.5	0.2	0.2
Television and Radio				
Radio/Phonograph	105	104		1
Color Television over 19"	49.1	47.2		1.9

See us at Comdex!
November 20-24
Canadian Pavilion Booth #36
The Annex of the Las Vegas Hilton,
between the Hotel and the Convention Centre.

INNER SPACE: *The Final Frontier ...*

Inner Space is expensive.

Place this photo next to the power supply in your system. You'll discover that a PS-22 requires only a *fraction* of the space swallowed by other products.

(Actual size: 10" x 5½" x 2", 3.1 lbs.)

We combine high efficiency with high power density: up to 325 watts continuous, 560 peak (fan cooled). Performance, absolute dependability, flexibility ... delivered on time.

You can win the space race! Some of the world's largest corporations use the free space supplied with the PS-22 for another drive, more memory: *the features you need to make your system competitive longer.*

The PS-22 Series: 9 standard and many custom variations, with 4 models certified by UL/CSA/TUV (IEC 380/VDE 0806). Production quantities 10-14 weeks, samples 4 weeks.

You are invited to call **Mr. Brian Ablett**, President, at (416) 298-0560, for information. or, in California, **Mr. Tom Miller** at (408) 947-1404

Notes: Various outputs available include:
5V 25, 35 or 45A regulated
±12 4 or 8A (12pk) regulated or semi-regulated
+24 6A (12pk) semi-regulated
-5 1A regulated
110/220 Strappable
Current limited outputs
Options include:
Remote sense, AC fail & Other voltages.

Brown
Manufacturing Ltd

Switching Power Supplies
Since 1973

31 Progress Avenue, Scarborough, Ontario,
Canada, M1P 4S6 • Telex 065-25175
Circle 67 on reader service card

Brown PS-22

"U" interface is Mitel's MT8972, designed to provide digital transmission service from central office equipment to the customer's premises. The MT8972 Digital Network Interface Circuit (DNIC) delivers the required 144 Kb/s over existing twisted copper pair wires and includes an Echo Cancellation Hybrid (ECH) technique which allows full duplex operation over a single twisted copper pair. Other ISDN support circuits available from Mitel include a T1/DS-1 and CEPT trunk interface, digital crossover switch ICs, T1/CEPT digital trunk phase-locked loop ICs, PCM filter ICs, and HDLC controller ICs. In addition, Smeaton adds, Mitel is developing S-type interface circuits to allow peripheral equipment to interface with the S bus and also serve as the network termination.

Because of Mitel's heavy R and D investment, its Semiconductor Division

is an industry leader in the development of software-controlled ISDN circuitry. This technological lead should result in greater share of the components market, thus providing the parent company resources for expanding its operations relative to product mix, market segments and geography.

CUSTOM POWER SUPPLIES

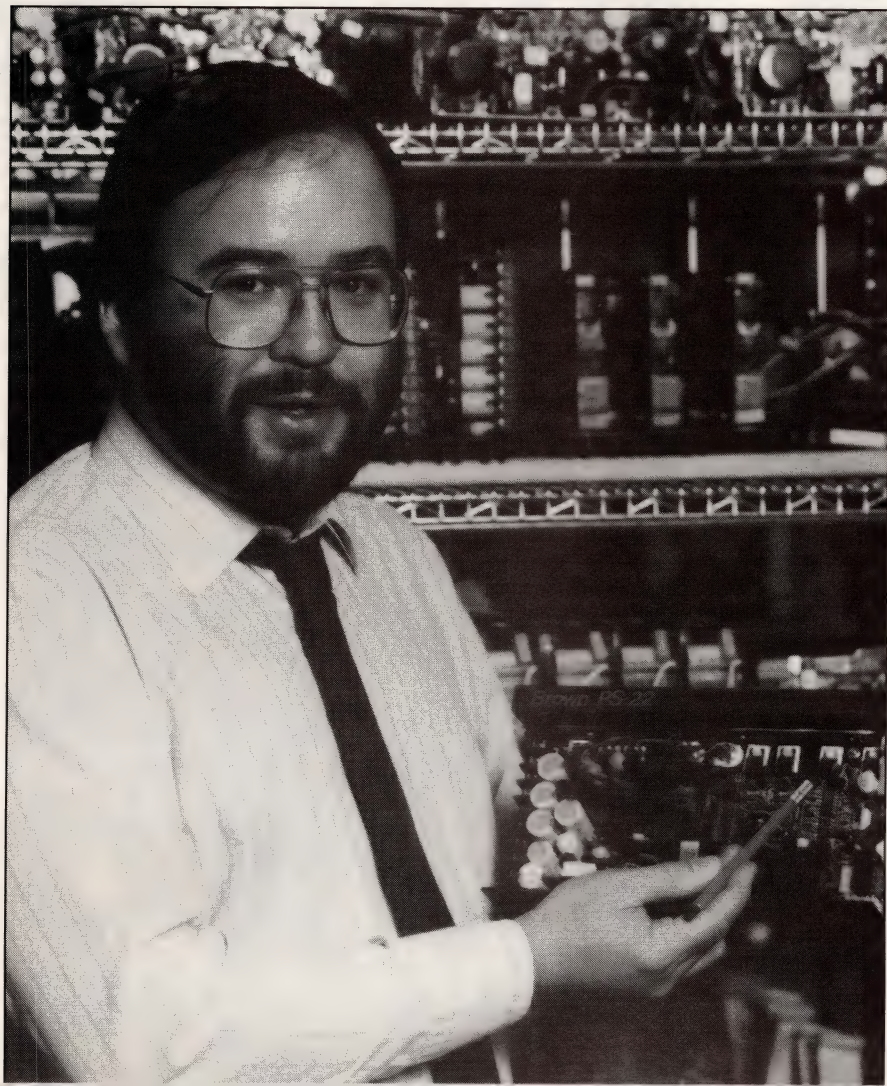
"You can't test or inspect quality into a product," insists D. Allan Brown, VP of engineering at Brown Manufacturing Ltd., "it's got to be designed in at all stages." That's the philosophy behind the 100W to 1500W switching power supplies built by Brown. Although reluctant to discuss specific 1985 sales figures for the firm, he is quick to comment that sales are up this year with business well on its way to doubling in size next year.

Years ago, Brown Manufacturing

made a profound decision to avoid the highly competitive, off-the-shelf switching power supply market and concentrate on custom and semicustom designs specifically tailored to meet customers needs. Another wise decision (it now appears) was to shun high-volume, low profit orders from the growing number of personal computer manufacturers setting up production lines. As a result of such decisions, Brown Manufacturing is not only escaping recession pangs, but is rapidly growing with one half of its products sold in Canada and the other half shipped to the U.S.

A good share of incoming business, Brown claims, comes from equipment manufacturers who need quick design turnaround from an experienced switching power supply house. Emergencies arise when a system design team realizes, near the end of their project, that insufficient attention was paid to the power supply section and multiple voltage outputs with tight regulation must be jammed into a tight area. That's where Brown's strength comes to bear. Allan Brown modestly admits that he's handled many "crash and burn" emergencies with prototypes delivered only weeks after the first spec meeting with a customer and production up to hundreds per month within a couple of months. But, he adds, he hardly encourages such situations since it gravely strains the engineering staff. The engineering group, Brown adds, is especially competent in the design of multiple output supplies requiring dynamic regulation for mechanical loads, such as disk drive motors; magnetic post regulation based on proprietary design provides fast response at moderate cost.

While many switching power-supply firms are still producing relatively large,



"You can't test or inspect quality into a product, it's got to be designed in at all stages." That's the philosophy of D. Allan Brown, vp of engineering at Brown Manufacturing Ltd., a supplier of custom switching power supplies.



Actual unretouched photo

PC Imaging ... \$1995.00

- 512 x 512 x 8 frame buffer (PIP-512)
- 1024 x 1024 x 8 frame buffer (PIP-1024)
- 256 colors/gray shades
- 16.7 million color output lut
- Real-time 8-bit frame grab
- DMA image transfer — 1M pixels/sec.

Matrox now offers two new image processing boards, the PIP-512 and PIP-1024. The PIP series of boards provides complete 8-bit image acquisition, frame buffering, and display capability for the IBM PC. A PIP board upgrades the PC, XT or AT into a LOW COST, PROFESSIONAL image processing workstation.

The PIP boards have all the high performance features characteristic of top-of-the-line image processing systems, with one exception: price.

The PIP-512 sells for only \$1995.00 in single quantity.

For more info on MATROX PC imaging; CALL TOLL FREE 1-800-361-4903.



matrox

1055 St-Regis Blvd
Dorval, Québec, Canada
H9P 2T4
Tel.: (514) 685-2630
Tlx: 05-822798

20 KHz designs, Brown has been delivering more efficient 100 KHz models for the past three years with an enviable 3W/cu.in. density; all supplies designed and built by Brown are fully certified to meet U.S., Canadian and European safety regulations.

Surface-mounted components are already in use in Brown designs, on preassembled control boards or modules which are later mounted to the final unit. Also, power MOSFETs have long replaced bipolar devices in a continuing effort to upgrade reliability. Quality control, Brown insists, is an obsession at Brown Manufacturing and has earned the firm a reputation that is instrumental in bringing in new business. Looking ahead to a new line of products, Brown describes an integrated battery backup system for small UNIX-based systems requiring 200 to 500W levels. The cost to the user of the UPS/power supply combination would only be about 20 percent above the cost of the power supply alone; presently a UPS add-on

costs as much as the power supply it protects during a blackout or brownout. The package, scheduled for early 1986 offering, is the first in a series of standard, off-the-shelf product from Brown. Before mid-1986, Brown adds, the firm will introduce a series of modular supplies, fully regulated, user-configurable, capable of being stacked and connected in various configurations.

DESIGN CENTER

Ontario design engineers have an alarmingly low knowledge level of semicustom integrated circuit technology. That's one of the distressing conclusions stemming from a recent Ontario Center for Microelectronics survey mailed to over 1,800 design engineers. The lack of competence in this mushrooming technology poses a serious threat to Ontario-based products struggling to compete for their share of domestic and world markets.

Why so much concern about this

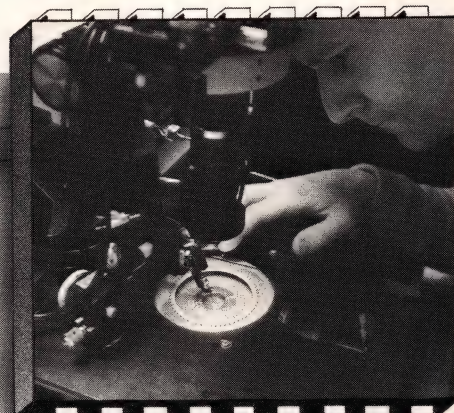
ailing? In today's intense drive for sales on a global scale, competition is fierce and merely matching a competitor's product just isn't enough; there is enormous pressure to offer an extra edge to close a sale. Semicustom IC chips offer a multitude of benefits to product enhancement such as smaller size, reduced power requirements, lowered manufacturing costs, and slimmer parts inventory while upgrading reliability, adding more functions, and preventing proprietary design details from falling into the hands of competitors.

"It is crucial that more design engineers quickly take advantage of opportunities to learn how to apply semicustom ICs", claims OCM president Lionel Hurtubise, "since more than \$510 million will be spent worldwide on these devices, a 70 percent increase from 1983. Canada, which will account for less than 1 percent, simply is not meeting the challenge of foreign competition in this area."

The Ontario Center for Microelectronics offers services ranging from full semicustom chip design to detailed educational seminars. In addition, OCM is an approved design center of GTE Arizona for gate arrays and NCR Colorado for standard cell ICs.



Canada's well connected ASIC design team



We're the Ontario Centre for Microelectronics, Canada's largest independent Application Specific IC design centre. Our job is to ensure Canadian made products include the numerous benefits of ASIC technology. Today's computer aids make ASICs quick to design and affordable, even in low volume applications.

The Centre's 25 engineers and technologists make up the largest and most experienced independent ASIC design team in Canada backed by state of the art CAD tools. OCM has direct access to 12 of the largest silicon foundries in the United States for their gate array and standard cell offerings. And we can now customize designs using a silicon compiler.

We can do the design for you, or you can do it yourself on our equipment. Anyway you figure it, OCM means total ASIC support from beginning to end. Call or write us today.

Ontario Centre for Microelectronics
400-1150 Morrison Drive
Ottawa, Canada
K2H 9B8
(613) 596-6690
Circle 71 on reader service card



ONTARIO
CENTRE
FOR
MICROELECTRONICS

Please return this coupon to: Ontario Centre for Microelectronics
Suite 400, 1150 Morrison Drive, Ottawa, Canada K2H 9B8

- ☐ Please send me more information on the Ontario Centre for Microelectronics
- ☐ Please have a technical representative contact me immediately.

Name

Title

Company

Address

City

Prov.

Postal Code

Telephone Number

Further, the survey reveals, engineers must rely on their suppliers and trade publications to become more familiar with the rapidly-changing technology. When asked to identify what they perceive as the major tools to accelerate their entry and skills, they put hands-on experience, a well-prepared textbook, and access to a nearby design center at the top of their list.

"Fortunately for the design community," Hurtubise notes, "OCM has already anticipated these and other needs and launched a successful hands-on chip design program early this year, have initiated a textbook on semicustom design, and are completing negotiations to open a branch of our Ottawa semicustom IC design facilities in a major center this year."

Other findings from the OCM survey indicate that engineers place reliability as the single most important reason for using semicustom ICs with design protection the least significant. Also, engineers not familiar with semicustom technology are burdened with such myths as high development costs, applications exist only for large-volume production runs, and the need for long design lead times; such misunderstandings can only further impede the entry of these chips into Canadian electronic products. Interest to date on semicustom devices has been stimulated mainly by fellow design engineers with market factors, such as activity by competitors and customer's needs, hardly considered. The importance of semicustom ICs must be heavily stressed by Canadian trade and government influences.

Among the diversified technical seminars offered by OCM are computer-aided engineering (CAE), computer-aided design (CAD), and computer-aided manufacturing (CAM)

workshops, plus sessions on gate arrays and standard cells, microelectronics packaging, Xenix-operating systems and C-programming language.

In addition to the training facilities, OCM provides in-house design services backed by more than 30 engineers and technicians; services include test strategy, schematic capture, test vector generation, function and timing simulation, chip layout, check of design rules, fault analysis, and prototype test. OCM is an approved design center of GTE Arizona for gate arrays and NCR Colorado for standard cells and is well versed in interfacing with silicon foundries of major semiconductor firms. Whether a firm is in need of semicustom IC training for their staff or wants professional assistance in designing a chip, or desires a chip to be designed, the Ontario Center for Microelectronics is available.

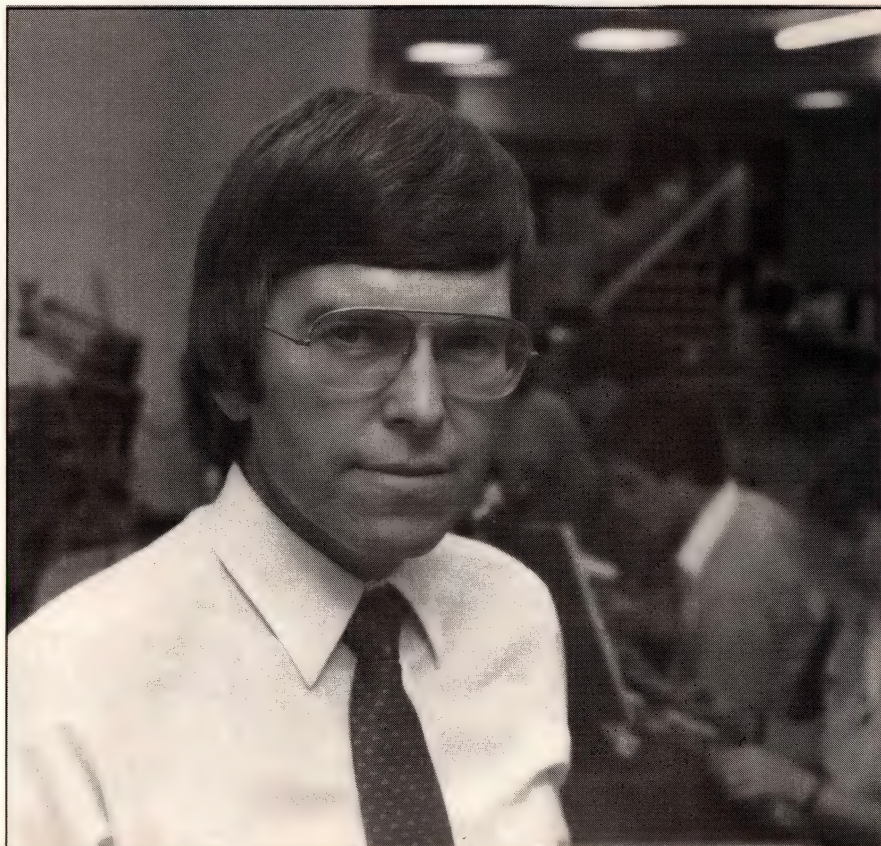
One profound point of the OCM study was the fact that the overwhelming majority of Ontario companies using microelectronics reported increased sales and lowered costs.

VMEbus DRIVER

Ranked among the top-ten North American designers and manufacturers of 16/32-bit VMEbus and 8/16-bit STD bus board-level products, DY-4 Systems is dedicated to quality and to customer service and support. With 1985 sales on its way to exceed \$7 million and 1986 targeted for 35 percent growth to \$10 million, the firm's major thrust is in the high-end military market which it has been serving for the past two years, according to DY-4 president Gary S. Dool.

The six-year old DY-4 (which stands for the Dynamic Four who started the firm) now includes 115 employees involved in the development of 16/32-bit hardware and real-time operating systems, as well as advanced VLSI and high-reliability packaging. One-third of sales is within Canada, with 44 percent shipped to the U.S., and 20 percent earmarked for European customers. Key application areas for DY-4 Systems are air-traffic control, military systems, data acquisition and processing, and process control for factory automation picking up momentum.

The VMEbus product lines from DY-4



DY-4 Systems' president Gary Dool sees a bright year ahead with 35 percent growth anticipated to bring sales up to the \$10 million mark. The firm is among the top-ten North American and suppliers of 16/32-bit VMEbus and 8/16 bit board level products.

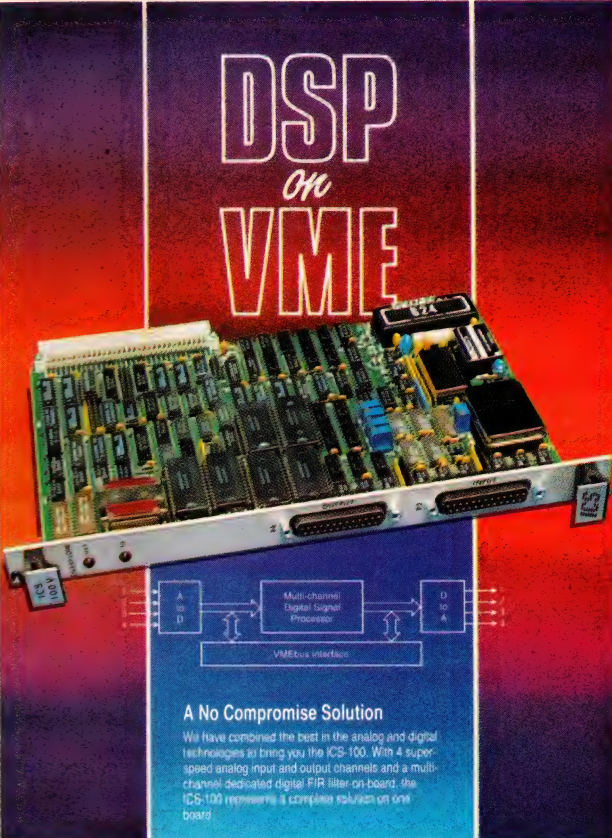
Systems are the SVME and DVME modules. The SVME series is packaged on a double Eurocard form factor of 233 mm by 160 mm while the DVME family is housed on a 233 by 220 mm double-extended Eurocard size. By offering both form factors, DY-4 can satisfy the needs of diverse VME bus users. The availability of systems monitors and software enables a customer to insert a DY-4 VMEbus module into a system and have it up and running immediately. The firmware packages available to support the intelligent controller family of DY-4 VME modules are an asset to the systems designer. Since an I/O subsystem interface is provided, the systems software engineer can concentrate on the architectural system solution rather than spending time on the low-level hardware details of the I/O subsystem.

DY-4 also offers a Unix-based VME bus development system, the DSM-6816, to meet the needs of the growing 16 and 32 bit system development market. Improvements in high-performance 16/32 bit microprocessors, high-density memory chips and hard disk units considerably extend the performance capabilities of compact, integrated systems. With appropriate interfaces and peripherals, such systems can be configured as CAD/CAM workstations or front-end processors for larger factory automated systems.

Optimistic about the future, DY-4's Dool is pleased with the firm's recent contract with Raytheon for an air-traffic control system for the Canadian Ministry of Transport. Further, Dool adds, DY-4 is readying a 32-bit processor for advanced processing applications scheduled for market entry in the second half of 1986.

REAL-TIME PROCESSING

Custom and standard solutions for real-time signal-processing applications are the targets for Interactive Circuits and Systems Ltd. In the short five years since its inception, the company has become a recognized supplier of a diversified range of products and services, with 70 percent of earned



**DSP
on
VME**

A No Compromise Solution

We have combined the best in the analog and digital technologies all in one IC-100. With 4 super-speed analog input and output channels and a multi-channel dedicated digital FIR filter on-board, the IC-100 represents a complete solution on one board.

500 KHz Sampling

All four analog input channels are simultaneously sampled at rates of up to 500 KHz and digitized to 12-bit accuracy. Digitized analog data can be directly applied to the filter and is also available in a 512 word FIFO for input to the host. The output DAC's can accept 12-bit data from either the host or the filter output. Optical isolations of both analog sections guarantee uncompromising performances.

100 ns/TAP

The 16-bit digital FIR filter directly handles 4 real or 2 complex input channel data supplied either from the A/D or the host processor with up to 255 taps per channel at a rate of 100 nsec per tap. Following decimation the filter output data is available in a 512 word FIFO for input to the host.

Unlimited Applications

Real-Time Multi-Channel Filtering, Harmonic Analysis, Matched Filtering, Digital Anti-aliasing, Cross/Auto-Correlation, Complex Adaptive Equalization, Hilbert Transformation, Spectral Line Extraction... are just a few of many direct applications of the IC-100.

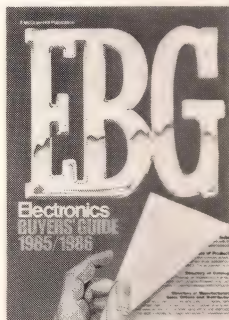
Advancing The Art Of DSP

**INTERACTIVE
CIRCUITS AND
SYSTEMS LTD.**

3101 Hawthorne Road, Ottawa, Ontario, Canada K1G 3V8 (613) 521-0590
TELEX 053-3928

*See us at Wescom!
Booth 2414*

Circle 73 on reader service card



Price: \$40 per copy

NOW AVAILABLE!

1985-86

Electronics Buyers' Guide

The industry's most often-used directory:

- 3 directories in one.
- Lists more than 4000 products.
- Lists over 5000 companies.
- FREE current catalog retrieval service.

Send order with payment to: Regina Hera

Electronics Buyers' Guide

1221 Avenue of the Americas, N.Y., N.Y. 10020

THE RELIABLE, PERFORMANCE, LCD'S

(1) FULL CUSTOM DESIGN CAPABILITY

Our experienced, in-house research and development teams can offer you the ultimate in professionally designed specialty applications with very wide temperature range operation.



(2) FAST TURN-AROUND

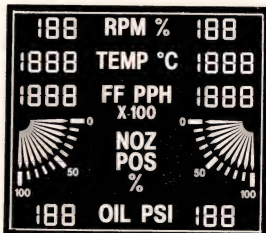
Our teams are dedicated to winning the turnaround battle with custom designs that are made good—and made fast!

(3) FLEXIBLE MANUFACTURING CAPABILITY

Try us! We can meet your delivery requirements from prototypes and short runs through the highest volumes.

(4) SPECIALIZED APPLICATIONS

We have solved virtually scores of difficult display problems in the industrial, avionic and military areas.



Give us a call soon. Our world of experience can help solve your toughest applications—whether on land, at sea or in the air.

(5) WIDE RANGE OF STANDARD PARTS

Of course our state-of-the-art manufacturing process can satisfy your requirements for a broad range of standard parts in direct drive or multiplex displays.

From 1 digit to 8 digit direct drive, and from 8 character alphanumeric to 32 character dot matrix, our displays can meet your industry's most exacting specifications.



Give us a call today



DATA IMAGES

Marketing Department • 1283 Algoma Road
Ottawa, Ontario, Canada K1B 3W7
Telephone (613) 744-3773

To receive our standard parts catalogues, please
circle reader service number 74

CANADA
SPECIAL ADVERTISING SECTION



Coreco Inc.'s Program Picture Book-100 allows the recall and display of annotated images digitized by the Oculus-100 board. Images appear in half-tones on the computer display; 53 images can be stored on a 360 Kb floppy disk.

revenue stemming from custom R and D services and the remainder from standard product offerings.

Combining a rare mixture of skills in technical expertise with innovative cost effectiveness methodology, ICS has successfully completed an impressive number of R and D projects in both the military and commercial sectors. The company's products are designed for advanced applications that demand the speed of dedicated hardware functions combined with the convenience of software configurability. One example of ICS' design capability is its sophisticated ADF-16 digital transversal filter board which achieves 20 million arithmetic operations per second and yet includes all the flexibility needed for direct application to a wide range of digital signal-processing problems.

Among the military and defense projects that ICS has been involved with are a real-time sonar beamforming system, a two-dimensional radar beamforming system, a fast-fourier transform processor, and a programmable digital clutter filter. In addition, ICS is active in electronic warfare and radar programs, including the development of an acoustic-optic receiver to provide simultaneous measurement of frequency and bearing direction of an emitting source.

A fully digital, time-domain interpolation sonar beamformer system, the SBF-32, offers unprecedented speed and accuracy in real-time beamforming. Based on a novel multi-channel interpolation filter architecture, the system handles 64 sensor data inputs and forms 32 beams simultaneously. The interpolation filter provides a 128:1 increase in the effective channel sampling rate which results in exceptionally

high beam steering resolution. For effective maintenance, the system is highly modular, using 32 identical beamforming cards to perform the shading interpolation and delay-summing functions. An RS-232 serial interface is included for running the resident diagnostics routine and selecting input parameters such as beam angle, shading, and scale factors.

The ICS FFT-212 is a fully parallel two-dimensional FFT processor designed for real-time beamforming for sampled aperture radar. The system accepts 256 (16x16) complex data inputs, each in 12-bit word, and delivers a 16x16 complex spectral frame every four seconds. Based on a novel stored product concept which eliminates coefficient quantization errors, the FFT-212 is highly modular and low cost. A Radix-2 FFT butterfly can be computed in 250 nsec as a result of the system's multi-level pipelining.

In the non-military area, ICS is active in remote sensing, geophysical and instrumentation areas. Among the specific projects are the development of airborne oil-spill and gas-leak detection systems, geophysical recorders and navigation

instrumentation. In addition, ICS is a major member of a team organized to develop the first Canadian stellar sensor system for satellite navigation.

Developed for the Canada Center for remote sensing, ICS' fluorosensor data correlator FDC-11 is an airborne instrument designed to detect an oil spill or other fluorescent target. The instrument interfaces to a laser fluorosensor which excites the fluorescence of a target with high energy laser pulses at a 100Hz rate.

The induced fluorescence is collected and dispersed into 16 spectral channels by a spectrometer. The collected data is compared against a stored reference of various types of oils and the results are displayed on a color monitor in a continuous real-time display. If any of the correlation results exceed given threshold limits, the display changes color indicating an oil spill alarm.

The FDC-11 includes a specially-designed multichannel correlator, an LSI-11 microprocessor, a real-time display processor, and a high-resolution color monitor. The system operates in real-time, thus eliminating expensive and time-consuming post-flight analysis of data to detect spills.

Computer vision products, both

hardware and software for IBM-PC, -AT, and -XT, computers, are the thrust of Coreco, Inc. Applications for such vision products cover a wide spectrum ranging from industrial quality control to medical and scientific programs.

COMPUTER VISION PRODUCTS

Among the hardware offerings are binary and gray-level frame-grabber boards with a resolution of 480x512 pixels which grab 30 images per second. The Oculus 100 binary image digitizer boards include 32K of on-board random-access memory, allowing storage of either one 480x512 image or two 240 x 512 images. The amplified video signal is compared to one of 256 software-selectable levels and a one or zero value is written into memory depending on whether the signal level is over or below the threshold limit. A pixel counter is included to count the number of black or white pixels in the entire image to provide lighting information for a given scene. Available on an optional basis are software packages to permit the board to be used as a character reader to turn typewritten or handwritten characters into ASCII code, as a picture book to store up to 50 images and captions on a single floppy disk, and an industrial inspector for sorting and dimensional inspection.

Motion analysis in real time can be performed by the Oculus 150 binary frame grabber with on-board processing circuits. An OR circuit is used to accumulate positive images, an XOR circuit permits comparison of two images, an AND circuit can be used to accumulate negative images, and images can be inverted with the NOT operation. Images can be compared in real time to a template by XORing the incoming images to a reference, with

Program Picture Book-200 from Coreco Inc. allows a two-screen display of high resolution images grabbed by the Oculus-200 board to be shown on an auxiliary monitor with descriptive text on the computer display. The application illustrated is intended as a creative selling tool for real-estate brokers.



oculus™

A COMPLETE LINE
OF COMPUTER VISION PRODUCTS
FOR YOUR VME* OR IBM PC
COMPUTER

Our line of computer vision products covers both hardware and software. It is the most comprehensive on the market. Judge for yourself.

HARDWARE

We offer binary and gray level **frame grabber boards** for the IBM PC, XT and AT. They all have a resolution of 480 X 512 pixels, and grab 30 images per second. Our Oculus-150 binary frame grabber contains **on-board processing** circuits that allow you to perform **motion analysis** in real time by accumulating images. It also achieves **real-time comparison of images** to a template by XORing the incoming images to a reference, and even performs **edge detection** in 67 ms. Our gray level frame grabber, the Oculus-200, contains self-incrementing address registers, and 256 Kb of on-board memory.

Options include a palette of 4096 colours, real-time image integration, and a co-pro-

cessor board speeding-up calculations by a factor of 100. These products will soon be available for the VME bus.

SOFTWARE

Half of our research efforts go into developing software for our products. Our Binary and Gray libraries of functions allow you to configure your own applications in a matter of hours: simply use the high level C language to call our efficient **machine language functions**, which include code for **pattern recognition** and **artificial intelligence** activities. Industrial Inspector is a menu-driven, user-friendly program that turns an IBM personal computer into an industrial inspection station. It can be used for **counting** objects, **dimensional inspection**, acceptance-rejection by **comparison to a template**, and **character recognition**. Our Picture Book Program lets you perform **image compression** and filing and is compatible with DBase II.

Our prices are beyond compare, either individually or in large quantities. We also develop custom software or hardware, and deliver turnkey systems. Write or call for the address of our nearest representative.

Motion
Analysis
with
Oculus-150



CORECO INC.
The CComputer REsearch Company

IBM PC, PC XT, and PC AT are registered trade-marks of International Business Machines, Inc.
*VME Products available first quarter 1986

555 ST-THOMAS STREET, LONGUEUIL
QUEBEC, CANADA J4H 3A7

TELEPHONE: CANADA (514) 651-3100
U.S.A. 1-800-361-4997

Circle 76 on reader service card

CANADA
SPECIAL ADVERTISING SECTION

edge detection performed in less than 70 msec.

The Oculus 200 frame grabber contains self-incrementing address registers and 256K of on-board memory with options for real-time image integration, a palette of 4,096 colors, and a coprocessor board capable of speeding calculations by a factor of 100.

Half of Coreco's research expenses, according to Coreco's president Dr. Daniel Crevier, is allocated for developing software for the product lines. An Oculus binary and gray library of functions enable users to configure their own applications within hours using high-level C language.

LCD DISPLAYS

Data Images Inc. has a clearly focused goal: to become the North American leader in LCD technology and the prime supplier of high-quality, specialized liquid crystal displays and modules. The firm was acquired by Litton Systems Canada, which wanted to complement its own in-house advanced avionics development activities. Data Images expects its 1985 sales of \$2 million to reach \$15 million by 1990, states Peter Jeffrey, vice president and general manager.

Close to 70 percent of the firm's product line involves fully custom TN liquid crystal displays, another 20 percent is based on fully custom dichroic LCDs, and the remaining 10 percent is taken by standard TN displays. The future product lines, according to Jeffrey, will focus on enhanced performance TN displays to withstand severe environments such as -50C to +90C as well as high vibration and humidity. The company is also continuing with its efforts to come up with improved materials that will optimize performance of dichroic LCDs in severe environments.

In early 1986, Data Images will introduce complete module packages housing the display, drive circuitry, lighting and interface electronics. And, Jeffrey adds, by early 1987 the firm will supply active matrix flat-panel displays currently under development by its sister division Panelvision.

CUSTOM AND SEMICUSTOM VLSI: SURVIVAL STRATEGIES FOR THE NEW ERA—R360



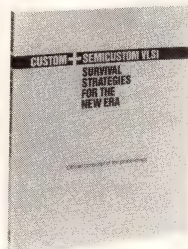
Custom and semicustom IC's have advanced to the center of the forum. Are you equipped to meet the challenges of an ever-changing industry?

Order the official transcript of this seminar, sponsored by *ElectronicsWeek* Magazine and Gnostic Concepts Inc. for an inside line on the questions of SURVIVAL.

Send \$150 or your company purchase order to:

Electronics Magazine Books P.O. Box 541 Hightstown, NJ 08520

Please allow 4-6 weeks for delivery. Money-back guarantee.



609/426-5070



You've got two weeks to put European locations to the Board.

Scotland, as a general location, you've pencilled. It figures on every corporation's European checklist.

But does any specific location recommend itself clearly?

Picture Edinburgh Castle, Scotland's most famous landmark, and remove yourself westwards 15 minutes.

You're in Livingston town, purpose-built for industry, set in beautiful open country.

You're on the M8 Motorway, 30 minutes from Glasgow's airport and 10 from Edinburgh's.

You've got a choice of fully serviced sites—including a hi-technology park—and a wide variety of available factories and offices.

You've got neighbours. Over 250 of them. Burroughs, Burr-Brown, Johnson & Johnson, Ferranti, NEC—to name just a few who are expanding vigorously.

You've got specially close research links with Edinburgh University, the Wolfson Microelectronics Institute and Heriot Watt's Computer Applications Services.

You've got Development Area status. Investment grants of up to 35%, rent-free periods of at least 2 years, plus European Community assistance.

And you've got us. The town's own Development Corporation.

We can put together a detailed personalized prospectus on Livingston for your particular industry. In hours if you push the panic button.

Could anything be clearer or more specific than that?



To: C. Anne Robins, PO Box 345, Old Greenwich, CT 06870. Tel: (800) 8511234.

Prove that Livingston is Europe's most logical location for my company. We are/are not pushing the panic button. BLOCK LETTERS PLEASE.

Name

Position

Company

Address

Zip Code

Telephone



**MAKE IT IN
LIVINGSTON**

EBW7

Europe's most logical location.



**Simpler, speedier
shielded connectors—
more new ways to put
the clamp on EMI.**

**Peace and quiet,
from AMP.**

Strong medicine for EMI/ESD protection on a budget. AMP offers next-generation shielding solutions right now, lightweight, good-looking, and cost-effective.

Tired of bulky, bolted-down notions of shielding? We offer versions of our discrete-wire and ribbon-cable connectors with simple snap-together shields.

They assemble in seconds, with far fewer parts to inventory.

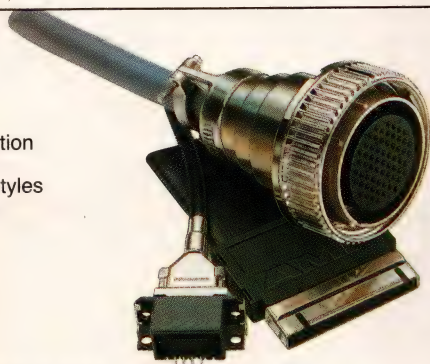
Can good looks and savings come together? We've got connectors with metal shielding on the inside, and—special note—connectors with metallized plastic shells: very light, very inexpensive, very practical. And still very attractive.

And we also offer shielded connectors for post-molding—a remarkably reasonable solution to your shielding problems if you're currently customizing your connectors.

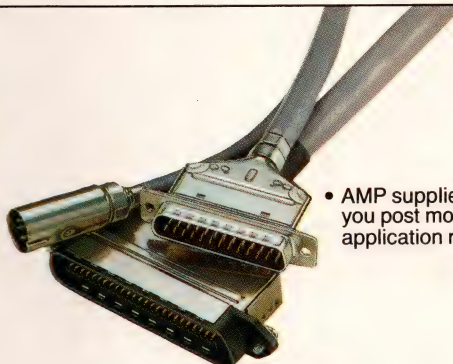
After all, AMP has been making connectors simpler and easier to apply for a long time. It only stands to reason we'd have some ideas for EMC as well.



- A complete selection of pin/socket or post/receptacle styles
- Cable-to-cable or cable-to-board



Call (717) 780-4400 and
ask for the AMP Shielded Connector Desk.
AMP Incorporated, Harrisburg, PA 17105.



- AMP supplies the shield, you post mold to your application requirements

AMP Interconnecting ideas

AMP, AMPMODU, and AMP-LATCH are trademarks of AMP Incorporated.

Circle 79 on reader service card

A Few Questions Fiber Optics

Why all the excitement about fiber optics?

Because this new technology has a number of advantages over wire and microwave communications.



For one thing, these tiny optical fibers are substantially smaller and lighter than wire cables; for another, they're almost immune to electromagnetic interference. They're particularly effective for the high-capacity digital signals that are making up more and more of today's telephone traffic.

What about testing those fiber optics circuits?

As you might expect, you need highly specialized test gear for this unique communications medium.

I heard fiber optics test equipment is heavy and expensive. Is it?

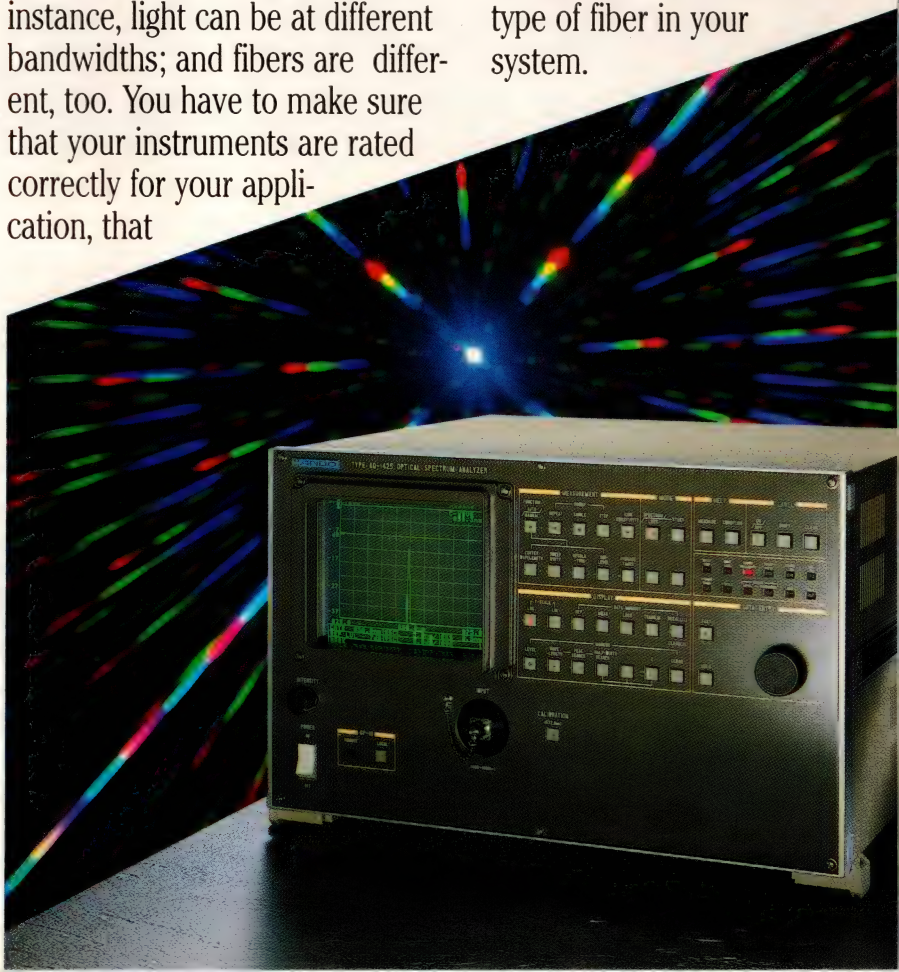
It doesn't have to be. For instance, Ando Electric, a major player in the fiber optics game, offers a digital-reading optical power meter that fits right in your pocket.

Is compatibility a problem?

There are actually many different kinds of fibers and light used. For instance, light can be at different bandwidths; and fibers are different, too. You have to make sure that your instruments are rated correctly for your application, that



you have the right adapters for the optical bandwidth and the type of fiber in your system.

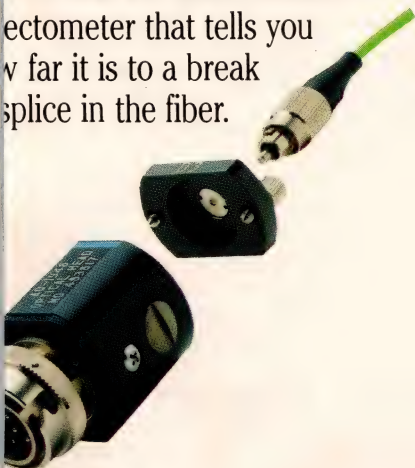


Shed Light on Testing.



What makes Ando so special?

Ando has everything you need — right off the shelf — to test from one end of your fiber optics line to the other. Laser light sources, optical power meters, spectrum analyzers for optical use, electro-optical converters — the list goes on and on. There's even a spectrometer that tells you how far it is to a break or splice in the fiber.



What else does Ando have to offer?

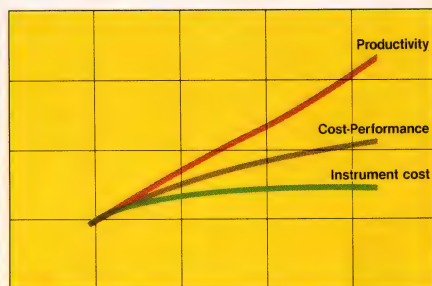
Glad you asked. Ando has been making communications test equipment for more than a half-century. So we know how to build accurate instruments that stand



up to the rigors of the bench and the toolbox. It's part of our total cost-performance concept.

What do you mean by "total cost-performance?"

Looking at **overall** results rather than just cost. Ease of setup, learning curve, accuracy, reliability, GPIB compatibility: they're all part of the equation. Put simply, cost-performance means that the bottom line isn't always visible on the price list.



If you have more questions about fiber optics testing, an Ando representative will be happy to help you.



ANDO CORPORATION

480 Oakmead Parkway, Sunnyvale, CA 94086 Phone: (408) 738-2636
7617 Standish Place, Rockville, MD 20855 Phone: (301) 294-3365

ANDO ELECTRIC CO., LTD.

19-7, Kamata 4-chome, Ota-ku, Tokyo, 144 Japan Phone: (03) 733-1151 Telex: 246-6425

ANDO EUROPE B.V.

"Vijverdam", Dalsteindreef 57, 1112XC Diemen, The Netherlands Phone: 020-981441 Telex: 18514 ANDO NL

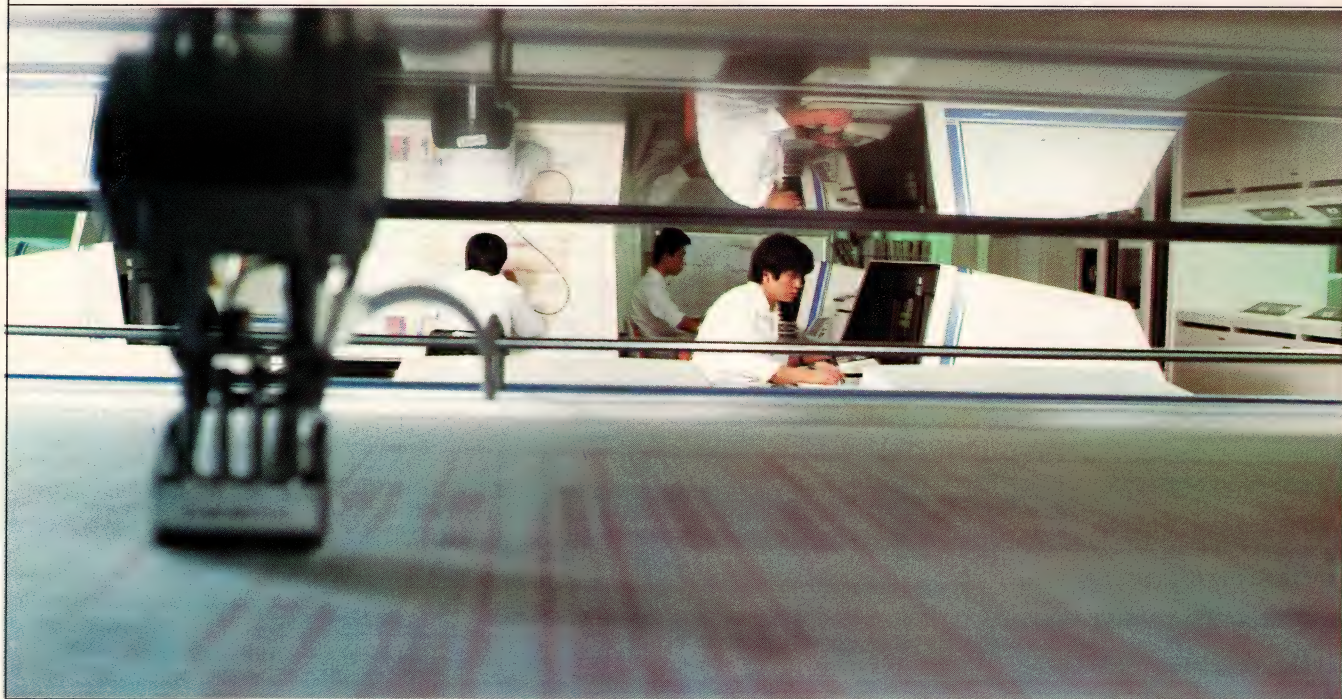
Circle 81 on reader service card

PROBING THE NEWS

WILL JAPANESE IC MAKERS COME ROARING BACK AGAIN?

YES, IF WHAT HAPPENED IN PRIOR MARKET UPTURNS IS THE RULE

by Jonathan Joseph



EYE ON TOMORROW. Engineers at Toshiba work with an advanced CAD system for VLSI as the company prepares for the upturn.

TOKYO

As the world continues to plod through the worst-ever semiconductor recession, Japanese semiconductor makers are quietly following a strategy that has them primed to move quickly after new markets once the upturn comes. That scenario should bring a shiver of déjà vu to U.S. chip makers because that was the strategy Japanese chip houses, powered by the financial and marketing muscle of their large, diversified corporate families, used to conquer the 64- and 256-K random-access-memory fields after earlier market upturns.

Japanese makers recovered quickly when the upturn began after the 1981 recession, grabbing the lion's share of the 64-K dynamic-RAM market and doing the groundwork for their near-total dominance of the 256-K DRAM market. The preparations now are similar. This time, the Japanese plan a coup de grace

for any American company's attempts to enter the 1-Mb race. Japanese companies even have their eye on U.S. positions in application-specific integrated circuits and microprocessors.

"Memory chips will still be made in the U.S. [after the recession]," says Nobuyoshi Ogino, director of the office of the president at Shin-Etsu Handotai Co., the world's leading wafer manufacturer. "But the makers will be of a different nationality."

For now, the Japanese have hunkered down to ride out the slump. But while thousands of U.S. semiconductor workers have been laid off in the last year, no regular Japanese semiconductor plant workers were laid off, according to a survey of the top semiconductor companies in Japan.

Their sales, which are down more than 30% in the U.S., are also down in Japan—but by only 20%—and most major Japanese electronics companies, even when their ailing semiconductor divi-

sions are factored in, will see an average increase in consolidated group sales of 7% this year, says Peter Rawle, an industry analyst with W. I. Carr & Sons (Overseas) Ltd., in Tokyo (bottom chart, p. 84).

The survival strategy followed by most of the Japanese semiconductor industry is simple: build in shock absorbers—such as diversification and the use of contract workers who are easily furloughed—to absorb the roughest bumps. Americans, on the other hand, have nothing comparable. The Japanese companies' cushion—which comes only partly from their membership in large vertically integrated conglomerates—allows for a flexible response to an extremely rapid drop in sales without suffering any lasting damage. "We have cut deeply into the meat, but at least we have left the bone intact," says Sutezo Hata, senior managing director Hitachi Ltd., citing a Japanese proverb.

That is not to say that the Japanese

are not suffering. Plunging chip prices have cut profits by an average of 23% among the six biggest companies in Japan this year, and analysts predict that the majority of the Japanese semiconductor divisions at the major electronics companies will at best break even for the year. All companies have been forced to cut back heavily on capital spending, and employees of some companies report that their semiannual bonuses, in good times equal to two months' pay, have been cut in half.

There have also been firings. Mitsubishi Electric Corp., whose officials declined to be interviewed, laid off in July 200 contract workers, who have six-month employment deals, and announced it would eventually lay off others. Indeed, shock absorbers in the Japanese semiconductor industry have their limits: "We can adjust, but if sales were cut 50%—that's something else," says Tsuyoshi Kawanishi, director of Toshiba Corp.'s semiconductor group.

FAMILY AFFAIR. Still, by international standards, Japanese semiconductor makers are sitting pretty. The biggest shock absorber for Japan's big chip houses is that they belong to families—some of the biggest in the world. For example, the parent company of the \$24 billion Hitachi group is—like the half dozen other Japanese *keiretsu*, or conglomerates—widely diversified for stability; it produces not only semiconductors but nuclear power plants and Japan's famous bullet trains, and it enjoys a nearly unlimited line of low-interest financing from banks that own its shares.

Japanese semiconductor companies are also widely diversified within the electronics field. The \$9 billion-strong NEC Corp., similar to Matsushita, Mitsubishi, Toshiba, and others, tries its hand at everything from supercomputers to rice cookers. Called the *wan setto*, or "one set" mentality, the strategy stems both from jealousy in not wanting their competitors to take the lead anywhere and from insecurity that has them constantly hedging their bets.

That strategy is paying off handsomely in these hard times. Of the various electronics divisions held by most of the major Japanese semiconductor makers in Japan—consumer, heavy industrial, telecommunications—only semiconductors have shown a net loss this year (top chart, p. 84).

Though NEC's semiconductor division showed a sales drop of \$248 million between April and September 1985 when compared with the year previous, its computer division registered a gain of \$255 million, more than compensating for the loss. And the 49% growth in telecommunications sales for Fujitsu Ltd. buried its 20% drop in semiconductor sales by more than \$8 million.



ONCE-OVER. Members of Toshiba's engineering staff look for defects in LSI patterns.



CHIP CHIEF. Toshiba's Tsuyoshi Kawanishi has a four-part product strategy.

The "one set" mentality has been applied effectively within semiconductor divisions also. Although just a few years ago the bulk of Japanese production of semiconductors was in memories, now the Japanese are pushing aggressively into other markets. Several years ago, NEC struck out on a risky path to



WARNING. Tomihiro Matsumura, NEC director, warns of possible cutbacks in the U. S.

develop its own microprocessor, and most Japanese companies are moving as fast as they can into the ASIC market. "Our fundamental strategy is a four-column bridge—discrete, bipolar, logic, and memory," says Toshiba's Kawanishi. Toshiba has only 20% of its production in memories, and much of that is

oriented toward the consumer market with products such as video tape recorders and compact-disk players. Sony Corp., which produced \$280 million worth of semiconductors in 1985, used two thirds of those in-house, primarily in its video and audio products. And Hitachi, the largest memory maker in Japan and the most exposed in the market downturn, is moving toward consumer and away from industrial chips.

Those who do not learn the lesson of diversity in Japan get a stinging rebuke from the marketplace. The newest entrant, NMB Semiconductor Co., a subsidiary of Minebea Co., built a \$140 million 256-K DRAM semiconductor plant earlier this year, hoping to cash in this spring as the low-cost seller when the chips were going for around \$8. But prices have plunged to \$1.50 in Tokyo, and NMB isn't even in production yet. "They are fools for building that plant," says one high-level industry executive. Other Japanese executives are saying that the only U.S. semiconductor makers that will ultimately survive are those that have strong in-house sales—the GEs, IBMs, and RCAs.

When all is in the family, shifting personnel to other divisions rather than laying them off is relatively simple. "Only 15% of Hitachi's production is semiconductors," says Hata. "The remaining 85% has been very busy." When it is necessary to make adjustments, something that "happens rather frequently," he says, Hitachi and its companywide union figure out where to shift people. Toshiba also makes adjustments short of cutting its loyal work force. "In Japan, when it gets bad like this, the company, workers, unions—all of us—draw together and suffer together," says Kawanishi. "If we didn't, that would be the end of Japan."

CUTS IN OVERTIME. The first personnel adjustment is to cut overtime. Knowing they can demand more from their workers than can U.S. chip makers, Japanese companies tend to hold down the number of regular hires and load on the overtime when the industry is at its peak. Many companies, including Texas Instruments Japan Ltd., had their line workers busy seven days a week earlier in the year when sales were brisk. When TI was beginning its layoffs in Texas, Hiyoshi Yoshizaki, chairman of TI Japan, was asked if there would be layoffs at the Japanese plants as well. "I guess what you can say is we'll cut back on overtime," replied Yoshizaki. According to Hitachi's

MINUSES AND PLUSES FOR JAPANESE MANUFACTURERS

(Percentage changes for first six months of fiscal year ending March 1986 from same 1985 period)

	Hitachi	Toshiba	Mitsubishi	Fujitsu	NEC	OKI
Sales	3	9	1	18	7	3
Operating profit	-24	-22	-32	-24	12	-8
Net income	-1	11	-15	-17	40	-34
Order backlog	-2	-6	-4	7	3	1

SOURCE: W. I. CARR & SONS (OVERSEAS) LTD.

Hata, "When sales are going up, our workers put in two or more hours of overtime a day." During a downturn, Hitachi cuts back on those hours. "It's like cutting the work force by 20%."

Still, not all Japanese workers are protected by the maternal corporate mantle. Some Japanese companies depend heavily on temporary workers, who are full-time and weekend workers on six-month contracts. In a downturn, Japanese employers let the contracts expire. But Mitsubishi is unusual in that such workers make up the majority of its work force. Most of the companies

Japanese companies will lay off their U. S. workers

fill in only 10% to 20% of the work force with contract people—often housewives, local farmers, or young women. Engineering staff members are never let go.

U.S. workers are also outside the complex web of relationships that companies have with their Japanese workers. When convenient, Japanese makers will do as in Rome and lay off Americans at their U.S. plants—after all, it is in the U.S. that their business has been hit hardest. Exports to the U.S. for some Japanese companies—such as Hitachi—are down more than 30% this year. Toshiba let go more than 100 workers at its 64-K DRAM plant in Sunnyvale, Calif., because of the industry recession, and Shinetsu Handotai cut 108 workers—25% of the workforce—from its Vancouver, Wash., operation in October.

One factor prevents more pink slips. "Trade friction is a moderating factor in our U.S. operations," says Tomihiro Matsumura, NEC Corp. senior vice president. But he adds a caveat: "If the slump continues, we will have to reduce production even in the U.S. Product sales in the U.S. are so damaged, it is costing us money not to cut back there."

NEC has already trimmed some of its 150-person Mountain View, Calif., staff, offering some of them alternate positions at the 420-employee NEC factory in Roseville, Calif., three hours away by car. Most declined the move.

But a Japanese worker would not have declined the offer. In fact, hard times are making short-term transfers, where the family stays behind, an ever more common occurrence in Japan. And a job transfer is better than no job at all. "During the 1973 oil crisis, I myself commuted to our memory-chip factory in Oita for three years," says Toshiba's Kawanishi. "We don't split up newlyweds, but for an older person like myself [55 years old], it's not so bad."

Japanese makers are also digging into a smorgasbord of financial options. Most of the major companies have been forced to cancel or delay plans for expanding capacity. They are all keeping research and product development funding up to current levels—especially for 1-Mb RAMs—which is usually equal to 10% to 15% of gross sales. Hitachi has delayed for at least six months plans for plant expansion both in Japan and at its Dallas site.

LAND DEALS. Other companies, such as Toshiba, bought land last year in anticipation that the boom would continue. Though the \$250 million loss Toshiba has chopped from its projected plant spending this year is significant, the cut-back won't hurt gravely, company officials say.

Most Japanese executives feel a pick-up in the semiconductor market is imminent. "According to the company, things have become a little better—only a little—but it will take time [for a full recovery]," says Toshiba's Kawanishi. "We have passed the bottom," says Hitachi's Hata. "We are going up, but the speed is very slow."

If Japanese executives have any advice to give their U.S. counterparts, it would be to diversify and hit the pavement running. "We are in a bad place, but at least we are out selling," says Hitachi's Hata. "We can't be that proud—our sales are down 20%—but we are surviving." □

OTHER PRODUCTS OUTDO SEMICONDUCTORS

(Percentage changes in sales for first six months of fiscal year ending March 1986 from same 1985 period)

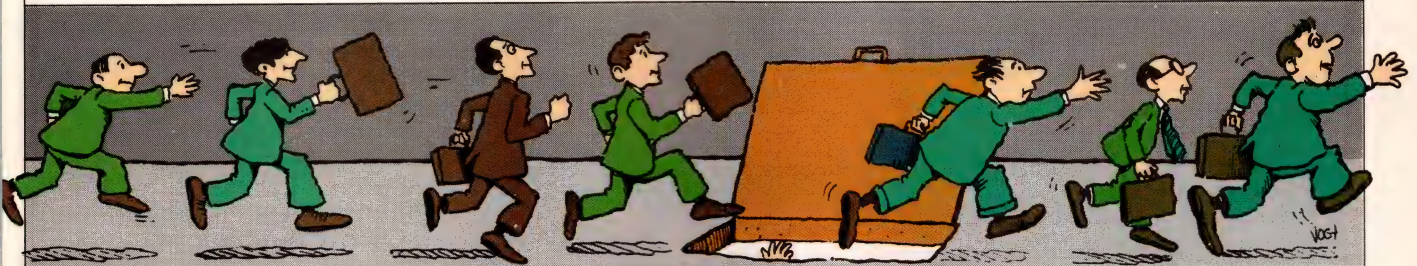
	Hitachi	Toshiba	Mitsubishi	Fujitsu	NEC	OKI
Consumer products	7	18	12	—	13	—
Heavy electrical products	8	10	4	—	—	—
Industrial electronics	-4	1	-13	—	—	—
Telecommunications	—	—	—	49	19	5
Computers	10	—	—	25	-21	-16
Semiconductors	-21	-10	-38	-20	-21	-16
Exports	-17	10	-4	22	1	-10

SOURCE: W. I. CARR & SONS (OVERSEAS) LTD.

FOR EXCITEMENT, CHECK OUT 5 1/4-IN. DISK-DRIVE MARKET

PRODUCTION PROBLEMS, LOW-BALL PRICING COULD TRIP UP MAKERS

by Larry Waller



LOS ANGELES

For sheer excitement, it looks like high-end 5 1/4-in. Winchester disk drives will be the market segment to watch in 1986. The stage is set for a dogfight as disk-drive makers try to establish a clear dominance in products of 175 megabytes and up. And stakes are high.

Survival will depend to a large extent on which makers the computer companies anoint as major suppliers. Recognizing this, the 10 or so disk-drive companies with such products either ready or in the offing are gearing up an all-out effort for the coming year. Most of them will be highly visible buttonholing prospects and eyeballing competitors this week at Comdex/Fall '85 in Las Vegas.

EARLY WINNERS. Three companies already have forged an early lead, stemming from their successes with 80-megabyte units over the past 18 months. Micropolis Corp., Chatsworth, Calif., owns more than half of this market with its model 1320 drive and is moving up with its 170-megabyte model 1350, sources say. But Priam Corp., San Jose, Calif., and Maxtor Corp., Palo Alto, also have strong positions. Priam's 500 Series offers up to 191 megabytes and Maxtor is debuting its XT-3000 high-capacity family, with up to 280 megabytes.

All three vendors are pushing into volume production and claim to have made initial sales. But most sources agree that the biggest contracts remain months away, as buyers wait for more entries into the market.

Competition will be worldwide, as Japanese companies aggressively seek U.S. 5 1/4-in.-drive business. Fujitsu America Inc.'s Storage Products Division, San Jose, has the 172-megabyte model M2246E, which is accorded a good shot.

Hitachi America Ltd. of San Bruno, Calif., already has a reputation as a leading price-cutter; and Toshiba America Inc.'s Disk Products Division, in Santa Clara, Calif., is also mounting a major campaign.

A dark horse in the race is Siemens AG of Munich. Its U.S. subsidiary, Communications Systems Inc.'s Memory Products Division, Westlake Village, Calif., has leapfrogged the 175-megabyte level with its 310-megabyte seven-platter MegaFile. Siemens has been evaluated closely by more than 50 companies, and has started volume production at its Munich plant, officials say.

But these front-runners are only the tip of the iceberg, says James Porter, drive consultant and editor of *Disk/Trend Report*, which follows the business from Mountain View, Calif. Porter insists that onetime drive heavyweight Control Data Corp., which for years dominated in larger 14- and 8-in. units, is a serious contender in 5 1/4-in. products, despite the Minneapolis company's overall financial troubles and pullout from some drive product segments. Its Wren 5 1/4-in. disk drives cover both the 85- and 170-megabyte ranges, and Control Data still enjoys selling clout with the old-line computer makers.

Other competition could come from latecomers to the 80-megabyte game, Porter says, even though much of the initial business here has been signed, sealed, but not yet delivered. These com-



panies could pick up business as second sources and move farther up the disk-capacity ladder, he notes. Among these is Quantum Corp., Milpitas, Calif., with its half-height 80-megabyte model Q280. Expected to debut at Comdex are a 95-megabyte drive from Seagate Technology Corp., Scotts Valley, Calif., and an 85-megabyte unit from Miniscribe Corp., Longmont, Colo. Furthermore, Porter says two additional Japanese makers could be factors: NEC Information Systems Inc. and Mitsubishi Electric Corp., both of Tokyo, have the disk technology.

Porter's newest market projections for 5 1/4-in. drives underscore the potential (table, p. 86). He says the 30- to 100-megabyte category has the biggest percentage growth predicted through 1986, as the 80-megabyte drives reach customers in volume. But the products with 100 megabytes and more will take off thereafter: "That's really where the action is," Porter concludes.

TOUGH NUT. Except for some grouching that Porter's figures are "10% to 20% too low," executives at drive companies generally agree with them. And none of them downplays how tough it will be to get up to these production levels. The hard-core problem facing all contenders is the great difficulties in turning out reliable drives in high volume; they must be built to precise electromechanical tolerances that grow ever more stringent as density goes above 40 megabytes and access time drops below 30 ms.

The result is "a relatively small percentage of demand is being met now," observes Rolf Brauchler, Quantum's director of marketing. Adds Micropolis founder and president Stuart P. Mabon, "I challenge anyone to produce 500 drives per day. Yet that will distinguish



WORLDWIDE DEMAND ZOOMS FOR HIGH-END DRIVES (in thousands)

Capacity (megabytes)	1984	1985	1986	1987	1988
30 to 100	306.6	699	1,154	1,393	1,592
100 to 300	10	40.6	1,378	310.5	492.7
300 to 500	0	2.6	21	46	75.5

SOURCE: 1985 DISK/TREND REPORT

the winners." Long-time observers of 5¼-in. hard disks, which date only from the late 1970s, take pains to remind late-comers that the industry has been plagued from the beginning by both lagging deliveries and unreliable operation.

NO WINNER. With the emphasis on pushing technology to the limit, some manufacturers have carved out solid reputations—but none has yet gained acknowledged preeminence on this score. In the judgment of Quantum's Brauchler, "there are no big leads or proprietary advantages." Most companies pursue a particular approach, emphasizing a certain configuration of disk platters per package, higher speeds or track densities, or a combination of these and other features. But the essential difference is how well companies manufacture, not the technology content of the product itself.

Nevertheless, the issue of which disk interface standard is best does stir up competitive juices. Because the workhorse but still-popular ST506 interface has a data-transfer rate of only 5 MHz, limiting speed, such companies as Micropolis, Maxtor, and Fujitsu have adopted the newer Enhanced Small Device Interface, which boosts the rate to 10 MHz.

But before ESDI has had a chance to carry the day, a rival backed by another camp—the suppliers of quarter-inch cartridge tape—has popped up and is getting growing support, to the confusion of both suppliers and buyers. That rival, the Small Computer System Interface, has the admitted advantages of being easier to integrate and allowing better multitasking operations. On the other hand, as ESDI proponent Mabon of Mi-

croplis notes, "it's six months behind and can cost roughly \$200 more." But he thinks ESDI and SCSI probably will coexist, both being served by many manufacturers.

The question that most divides 5¼-in. manufacturers is product pricing. Critics point accusing fingers at companies that aggressively pursue 85-megabyte market share at the expense of profits. Most extreme were charges leveled at Hitachi, Toshiba, and Micropolis, among others, for dropping their prices to under \$1,000 for some customers. Competitors such as Maxtor and Fujitsu say these tactics are self-defeating, because the artificially low prices are too low for

A worldwide fight is developing for the 175-megabyte market

decent profits and put pressure on all suppliers. Both companies deny the charges, but Mabon points out that high-volume customers obviously get a better deal. "Our prices are based on manufacturing costs, with a 25% to 30% margin added." Across the industry, current 85-megabyte prices average about \$1,000 to \$1,300 per unit.

TROUBLE AGAIN. But the same controversy is again starting over 175-megabyte drives and promises to heat up relations among suppliers as customers get nearer to signing up. One way to tell where prices should be at a given stage of a disk-product life cycle comes from *Disk/Trend's* Porter, who has tracked them for years. Generally, he

CHOICE. The interface, a disk drive's least visible part, is stirring controversy.

says, "when the volume of a given type doubles, the price should drop 20%." Although the prices of the 175-megabyte drives are still being fine-tuned, they are currently running substantially less than twice the 85-megabyte range.

One pleasant surprise for U.S. drive makers has been that Japanese companies, particularly Fujitsu, have not yet made serious inroads into the high-performance market above 40 megabytes. Many executives think the reason is unique to 5¼-in. drives, among the entire spectrum of electronic products. "It's the first Japanese product which has no domestic Japanese market," explains Maxtor's Robert Teal, vice president of marketing and product assurance.

"They [Japanese competitors] don't seem to have their hearts into this yet," adds another U.S. official, perhaps too optimistically. The tried-and-true Japanese path to U.S. success, as Teal notes, is "years to debug and get quality up and prices down with friendly accounts at home."

Arguing with this assessment is Michael Gluck, vice president of the Fujitsu disk operation, who gives another reason for not showing early momentum: "It's because I don't give away the store" with low-balled prices. He claims a number of recent contracts raised Fujitsu's standing considerably.

U.S. drive makers have another edge on Japanese companies and are starting to exploit it. Because Japanese drive operations are always one arm of an integrated computer company, potential U.S. customers could have reason to worry about proprietary data leaking out, explains James W. Adkisson, executive vice president for marketing and sales at Priam. "We're trying to make it clear to customers that if you bring in a Japanese drive company as a vendor, you're really bringing in a computer company. It's a Trojan horse in your midst." This argument is finding receptive ears, he says.

Though manufacturers of 5¼-in. drives are confident they can find a spot in the unfolding 175-megabyte market segment, it is too soon for any to claim an advantage. "It has the characteristics of a wide-open horse race at this point," predicts Micropolis' Mabon. Moreover, earlier success at the 85-megabyte game carries little weight with customers. "Everyone has to start all over."

And, even though this product issue remains to be settled, the inexorable 18-month product cycle churns on. Notes Mabon without enthusiasm, "The battle for 300 megabytes and above will start next NCC-time." □

AT&T HAS SECOND THOUGHTS ABOUT COMMODITY CHIPS

A NEW STRATEGY AIMS AT CORNERING SMALL NICHE MARKETS

by Tobias Naegele

ALLENTOWN, PA.

When a newly deregulated AT&T Co. decided two years ago to jump into the commodity-chip market, the massive telecommunications company found that its biggest asset was also its biggest problem—the AT&T name. “It’s taken a long time for the marketplace to recognize us” as more than just a phone company, says Donald Liedberg, national sales manager for AT&T Technology Systems Group, the parent unit for the company’s semiconductor division. “There’s skepticism out there about whether we’re here to stay” in the chip business.

Despite AT&T’s size, it now appears that the company is neither capable of, nor interested in, dominating the commodity-chip market. Instead, the strategy is to corner some of the smaller niche markets, such as microprocessors, peripherals, and military and specialty memories, and use the commodity arena to earn a reputation as a reliable supplier in a field in which it is still a mystery contestant.

Just how much the marketplace has come to recognize AT&T as a supplier is hard to judge. The company does not release sales figures, so its market position can only be guessed at. Of the \$530 million worth of MOS integrated circuits produced by AT&T worldwide, only about \$25 million worth will be sold on the commercial market in 1985, estimates Mary Swanson, a market-research analyst at Integrated Circuit Engineering Corp., Scottsdale, Ariz. That figure is negligible compared with ICE’s \$900 million total for Intel Corp. or its \$1.165 billion estimate for Motorola Inc. ICE’s total for worldwide MOS IC production in 1985 is \$5.3 billion. AT&T would not comment on the figures.

Low yield may be one factor hampering AT&T’s inexperienced marketing

team in the commodity market. Analysts worry that AT&T is suffering from yield problems, which they say is to be expected from such a fast ramp-up in production.

Those worries are fueled, furthermore, by AT&T’s reticence regarding its production capacity and sales figures. The company says yield is not a problem and hopes such sentiments will be washed out by the upbeat comment generated by the introduction of its 1-Mb dynamic random-access memory. AT&T

enough for AT&T to push its “one-stop shopping” scheme as a supplier. The strategy is to lure the customer in with the unusual—such as the 1-Mb DRAM.

“We want to use our memory business to generate the other parts of our business,” Liedberg says. “We think our real business will be in the custom circuits, microprocessors, and other yet-to-be-announced very large-scale ICs.”

The company is leery of letting commodity chips gain too large a share of its sales, having witnessed the pitfalls

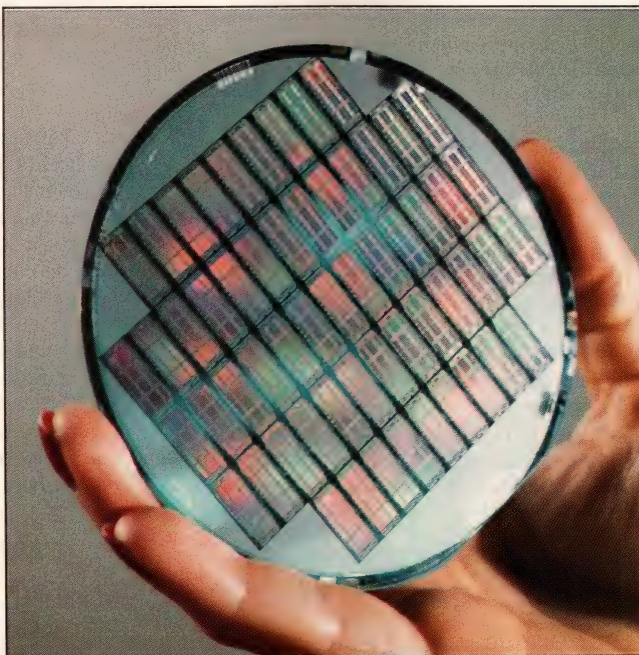
that can doom a memory house, such as United Technology Corp.’s Mostek. UTC finally closed its struggling chip maker last month after weeks of speculation about the subsidiary’s future. Liedberg says AT&T wants commodity memory to account for no more than the 5% to 30% share of semiconductor business it has now.

“We would never let ourselves get to the point where memory was 80% of our business—even if we could sell that many,” Liedberg says. “Our strategy has been to lead the process development with memory and use the process developed there for other products. The 1-Mb DRAM will be the kingpin for our 1- μ m CMOS poly-cell process.”

Those who watch the industry closely offer mixed reviews. AT&T is an exciting company and a guaranteed success, according to Charles

Clough, president of Wyle Laboratories, an El Segundo, Calif., semiconductor distributor. But a financial analyst who asks not to be identified views the venture into the commodity business as a mistake and says its only redeeming feature is that the venture might help make AT&T’s internal production more efficient by expanding sales beyond the company’s captive market.

Clough, who has talked with AT&T about distribution rights and hopes to win a contract with the giant company soon, calls AT&T “one of the top five



RAMPING UP. AT&T’s 1-Mb DRAM will go into volume production on 5-in. wafers during the first quarter of 1986.

thinks that could also have a positive filter-down effect on sales of its 256-K DRAMs and its 32-bit microprocessor chip set.

“From our standpoint, we started with a 0% share of the market, and you can’t go anywhere but up,” says Liedberg, acknowledging that all is not rosy. “In terms of quantities, we’re very near plan with the 256-K. But with the erosion of prices, revenues aren’t where we expected.”

The hope is that the megabit chip will attract customers’ attention long



Ever notice how some people always seem to have the right answer? No matter what the situation, they always seem to be a step ahead.

And they're successful...the first in line to lead an important project...the first in line for a promotion. It's certainly not magic. Usually it's a combination of hard work, brains, guts and desire.

It probably means they read *Electronics*...regularly.

Electronics has helped propel many a manager and engineer to the front line...to the "leading edge" of the industry. And just as we've been providing many of your colleagues with the right information, the *important* information-when they need it most-so too can we provide it for you.

Every week an *Electronics* subscriber receives an issue crammed with the latest information on new products, developments, concerns and trends in the worldwide electronics industry.

When you become a subscriber, we'll supply you with the intelligence you need to make the big decision, or the every day decision to further your career and reap profits for your company. For a taste, just browse through the issue you're holding.

But, you really don't have to believe us. Just ask the person who's always a step ahead.

To become a subscriber, just complete and mail the insert card in this magazine. If subscription card is missing, write: Circulation Manager, *Electronics*, P.O. Box 511, Hightstown, N.J. 08520.

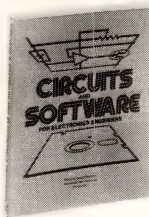
Electronics
The Voice of the industry



SOLUTIONS TO DESIGN PROBLEMS

CIRCUITS AND SOFTWARE FOR ELECTRONICS ENGINEERS

Order # R370



This invaluable resource is available for only \$19.95. Focuses strictly on design problems and delivers professional, innovative solutions for your most demanding projects. **STAY ON TOP OF THE LATEST CIRCUITRY DEVELOPMENTS.** Order your copy today! Send \$19.95 to:

Electronics Magazine Books, McGraw-Hill Intl. Publications Co. Maidenhead, Berks. SL6 2QL, UK
European Circulation Center (Tel. 06281 23431; Telex 848640)

semiconductor manufacturers in the world." He adds that "they have more potential than anyone."

Clough also thinks AT&T's made-in-America image will help it in a market fraught with overseas competition. "The guys that buy chips are just like you and me. They've had it with this overseas stuff," he says. But even the optimistic Clough agrees that AT&T has moved into the market slowly and "perhaps too cautiously."

When AT&T announced its 1-Mb DRAM in September—the first part of its kind to be offered in commercial samples—it sent a resounding message to competitors and potential customers alike that it is indeed serious about becoming a force in semiconductors. Getting the megabit chip out first was a major coup whose significance was not lost on the people who will make AT&T's venture sink or swim.

"The first guy there should be getting the first orders," reasons Gary Bulger, product manager for memory and processor integrated circuits at AT&T Technology Systems' Electronic Component Division in Allentown.

SALES TOOL. Gaining recognition as an industry leader is of the utmost importance to AT&T because that translates into sales. Through the sheer size of its Bell Laboratories research arm, AT&T boasts more technological muscle than almost any other company in the world. Moreover, AT&T is too big to be satisfied with a tiny portion of the market. The company's strategy is firmly rooted in blazing a trail with leading-edge technology.

Liedberg expects to do that by relying on Bell Labs' technology to stay on top of the market. The company has high hopes for its semicustom IC work and for a pair of specialty memories, the dual-port RAM and the video RAM, also

Beating competitors into the megabit arena was a coup for AT&T

known as row-addressable RAM.

The dual-port RAM is a single very large-scale IC designed as an interface device for asynchronous multiprocessor systems, says David Beecham, head of the Memory Design Department at AT&T Bell Laboratories' Allentown facility. The clocked CMOS chip consists of a 2,048-by-9-bit static RAM that can be asynchronously accessed from either of two separate ports. Contention is greatly reduced: a single master circuit controls multiplexing between the ports.

AT&T and Texas Instruments Inc. are the only two companies currently offering a 64-K row-addressable RAM, and

AT&T thinks its chip has great potential. "A lot of people think this market will really take off," Bulger says. He cites a projection by Dataquest Inc., the San Jose, Calif., market-research firm, which claims that these chips will account for 30% of the total DRAM market by 1990.

This chip, consisting of a 64-K DRAM attached to a shift register, is well suited for video applications because the shift register can put out a high-speed

AT&T has high hopes for custom ICs and specialty memories

serial data stream at 20 MHz.

In addition to being first with the 1-Mb DRAM and leading the field with the 64-K row-addressable RAM, AT&T early next month will introduce the industry's first 256-K DRAM to meet full military specifications. Although AT&T executives pooch-pooch the notion that they are in a continuous race with the competition, the key marketing and design people acknowledge that it's do or die when it comes to memory.

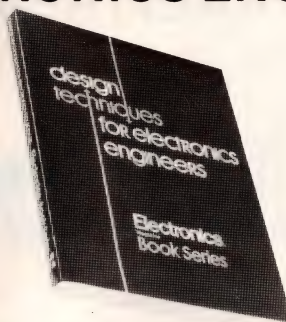
"You always hustle in memory," says Beecham, whose office decorations include a 12-in. wafer done as a promotion. "It's the nature of the beast."

AT&T currently produces circuits on 5-in. wafers at four facilities in the U.S.—Kansas City, Mo.; Orlando, Fla.; and older plants in Allentown and Reading, Pa. In May, AT&T acquired a fifth U.S. plant, a former Synertek facility in Santa Clara, Calif., that will be in production shortly. It will open a sixth near Madrid in 1987 as a joint venture with Compania Telefónica Nacional de España. The Orlando site, where the company will produce its dual-port RAM chips, began pilot production this year. The Kansas City manufacturing site for the 256-K and 1-Mb chips opened in 1984.

The 1-Mb DRAM will go into volume production on 5-in. wafers during the first quarter of 1986, Liedberg says, but he is not sure what initial demand will be like. "This is the first time there is a change in [industrywide] pinout with a new generation of memory," he says. "A lot depends on how willing people will be to change the boards they're using." But he notes that many customers have incorporated the necessary changes already.

Liedberg says the market for the extra-dense memories will be split into two groups: customers to whom increased memory density is so important that price is no barrier, and those who will wait for parity pricing—that is, for the price to fall to within four to seven times the going rate for 256-K parts. □

DESIGN TECHNIQUES for ELECTRONICS ENGINEERS



Expert guidance at every point in the development of engineering project-making measurements, interpreting data, making calculations, choosing materials, controlling environment, laying out and purchasing components, and interconnecting them swiftly and accurately. Nearly 300 articles from *Electronics*' "Engineer's Notebook," with more than 500 diagrams and tables.

Order your copy today! Send \$17.95 to:

P.O. Box 541
Hightstown, NJ 08520
609/426-5070

OR

McGraw-Hill
Int'l Publications Co.
Attn: ECC
McGraw-Hill House
Maidenhead, Berkshire SL6 2QL
England



Ten-day money-back guarantee. Allow 4 to 6 weeks for delivery.

1	Exxon	26	AT&T Technologies	51	Georgia-Pacific	76
2	General Motors	27	Boeing	52	Monsanto	77
3	Mobil	28	Dow Chemical	53	W.R. Grace	78
4	Ford Motor	29	Allied	54	Signal Companies	79
5	IBM	30	Eastman Kodak	55	Anheuser-Busch	80
6	Texaco	31	Unocal	56	Nabisco Brands	81
7	E.I. du Pont	32	Goodyear	57	Johnson & Johnson	82
8	Standard Oil (Ind.)	33	Dart & Kraft	58	Coastal	83

27 million Americans can't read. And guess who pays the price.

Every year, functional illiteracy costs American business billions. But your company can fight back...by joining your local community's fight against illiteracy. Call the Coalition for Literacy at toll-free **1-800-228-8813** and find out how.

You may find it's the greatest cost-saving measure your company has ever taken.

A literate America is a good investment.



Coalition for Literacy

The industry's leading coverage of international technology.

In Electronics.

Electronics is back—with the industry's top reporting on international electronic technology. In the first half of 1985 alone, Electronics—with its worldwide bureau of correspondents—published more than 140 articles on international technology. Important articles with news and analysis that leaders in the field can't afford to be without, such as:

January

Philips Uses MBE for Lasers
Siemens Readies Commercial ISDN
Japanese Chemical Firm Moves from Soap to Floppies
Italian Firm Seeks Allies to Crack U.S.
Japan Pursues Role in Space
Bellman Switches on Italtel for Expansion
Robots get Smart in Japan
ITT Invests in European Units Crack U.S.

February

Europe's Esprit Finally Sets Sail
LSI Logic Counts on Sandfort to make its Mark in Europe
Upstart Vendor Makes Waves in Japan's Robot Market
NEC Fashions New Fab Process
Olivetti's Viti Directs ET Designs that Marry Bus & Art
German Startup's Success Surprises Europeans
Britons Seek Tolerant Chips
OBI Rains on IBM's Parade
Mega's Friedrich Aims to Cut Asian Lead in Memories

March

British GaAs Chips Go to Market
NEC's CPU Leapfrogs IBM
Hitachi CPU Challenges IBM
France's Lansat Rival Set for Fall Launch
Olivetti Stakes Claim in Video Typewriters
Italian VLSI Chip has the Right Accent
Koreans Try for VCR Replay
Germans Push X-ray Exposure
There's Life in Resistors, German Company Finds
UK Beats a Path for Europe's Race

April

German System Meets New ICAO Standard
West Germans Squabble Over Choice of IFF
Britain Promotes Open Architecture
US Makes Progress in Japan Telecom Talks
Japan's Lead in Optical Disks: It's Part of the System
Daisenberger Guides US Firms through Red Tape
Asia: It's No Longer Just Japan That Threatens US Markets
Malaysia: Top Shipper of Discretes
Indonesia: Domestic Sales are the Lure

May

Thomson's VCR System Clears Up Doubts
ICL Banks on Networks and Japanese Chips
Min Blazes Bright Path for Korea's Gold Star
Asia: The Four Dragons Rush to Play Catch-up Game
Singapore Casts Lot with Software
Philips' Eurom Chip Finally Debuts
Sagging Prices Sting Japanese Producers
British Telecom Spreads Its Wings with Mitel
South Korean IC Maker Seeks World Markets

June

Plessey Switches Off Flash ADC, Saves Power
Sony Campaigns Hard for BMM Camcorders
Japanese Quit on IBM Software, Turn to UNIX
Apple Tries Again to Blast Off in Japan
Has the End Come for European Chip Makers?
SIA Protest May Not Stem Trade Tide
Now It's Korea's Turn in the Robot Market

And that's only in six months!

Readers depend on us for this full scope of technology coverage worldwide. Shouldn't your selling message be in Electronics' environment of pivotal technology reporting and analysis?

Put your advertising where the electronics attention is. Call Electronics today, at 212/512-3140, to reserve your ad space. Outside the U.S. contact your sales representative.

Electronics is back. Shouldn't you be back as well?



For active or passive needs, a change to CLS can boost productivity.

If you're ready for another laser trim system and want to increase productivity and decrease problems, the system to add is the CLS-37S. Built for high-volume, high throughput demands, the CLS-37S is more affordable to purchase and more cost-effective to operate.

Even if you currently operate another manufacturer's trimmers, adding a CLS-37S can help you trim costs and enhance capabilities. Its many benefits can be applied to

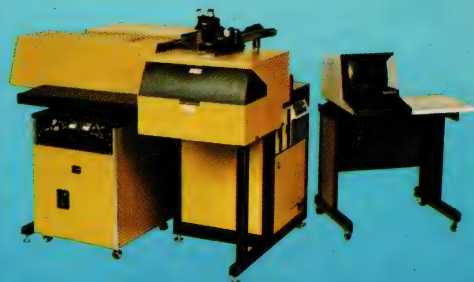
passive trims, or active trimming to ac and dc voltage or time parameters. It can even handle capacitance trimming; and an IEEE-488 bus interface module is available. An air-bearing step and repeat handler and a new cartridge feed stack loader are also optional.

In addition, the CLS-37S is trimmer in size than other systems. Its advanced design has made it smaller and less complex than the older generation of trim systems sold by others.

Designed as "the smart laser trim system," the CLS-37S is backed by the industry's most intelligent software operating system. So easy to use, unskilled workers can learn to program the system in just days.

For lower operating costs, Chicago Laser has taken extensive measures to minimize the chance of downtime. That process begins with well-proven designs and rigid quality-control standards. Chances of downtime are further reduced by the system's modular construction and advanced diagnostic programs.

For a detailed appraisal of how the CLS-37S can fill your needs, contact Chicago Laser Systems.

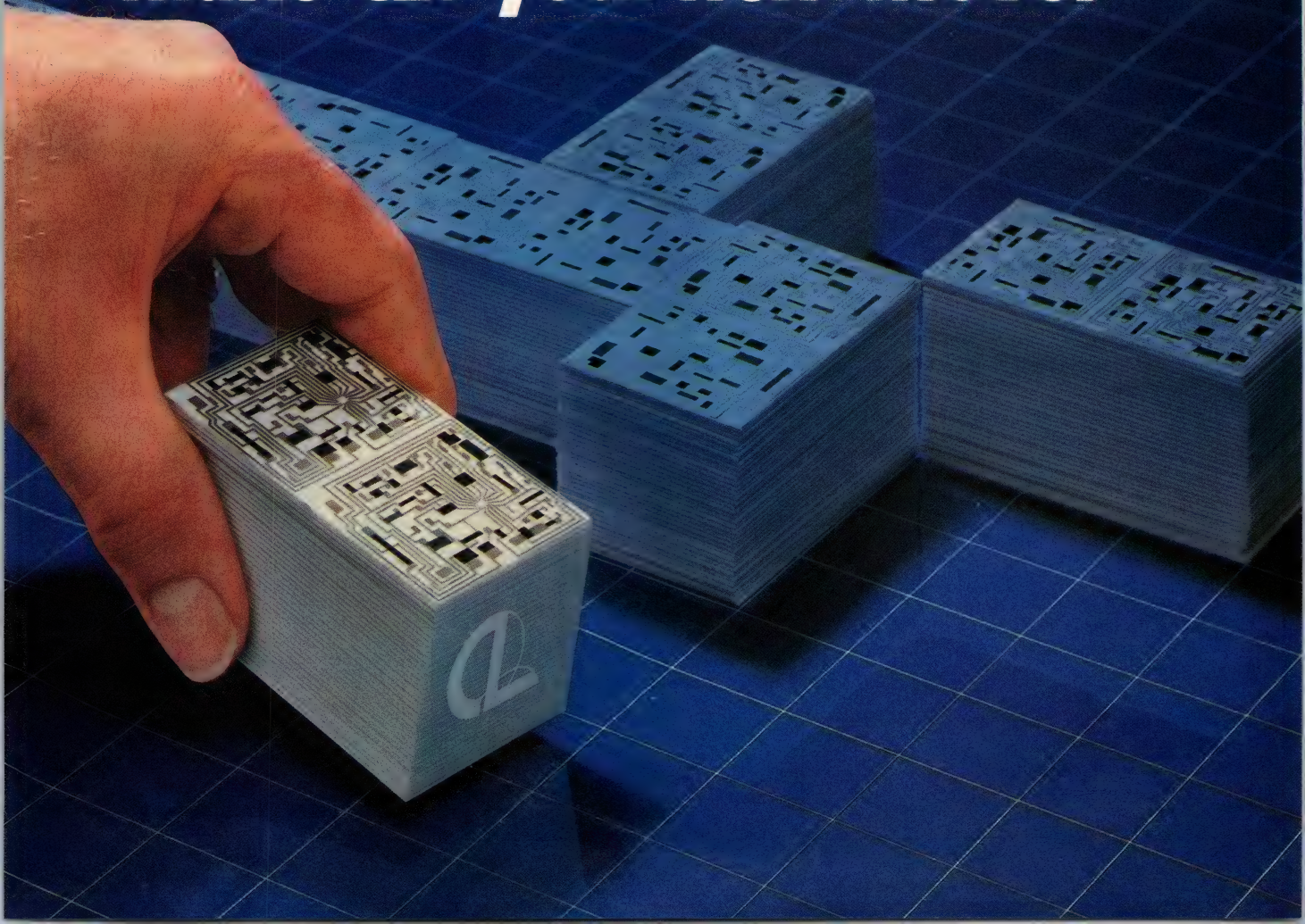


Chicago Laser Systems Inc.

4034 N. Nashville Ave., Chicago, IL 60634 • Phone 312 • 282-2710 Telex: 671-1269

Circle 89 on reader service card

For lower-cost laser trimming, make CLS your next move.



IS AMD'S TEXAS STRATEGY GETTING IT INTO TROUBLE?

THE CHIP MAKER'S AGGRESSIVE EXPANSION PLUS THE DOWNTURN EQUAL A PRECARIOUS POSITION

AUSTIN, TEXAS

Advanced Micro Devices Inc. continues to shift its U.S. volume-production base from crowded Silicon Valley to the wide open spaces of the Lone Star State. More than half of AMD's revenue already derives from a half dozen wafer-fabrication facilities in Austin and San Antonio. But as AMD continues its Texas Tilt campaign, sales continue to slide sharply.

The steep 1985 market downturn, the aggressive Texas buildup launched during AMD's meteoric rise over the past several years, and a no-layoff pledge from chairman W. J. (Jerry) Sanders III are placing the 16-year-old company in an unusually precarious position, say analysts who attended a recent briefing at AMD's Sunnyvale, Calif., headquarters.

"In terms of revenues being off, AMD is in the same boat as other semiconductor companies," says Andrew Kessler, a securities analyst at Paine Webber Inc., New York. "The difference is Jerry Sanders has this no-firing policy and, unfortunately, he's oversized his company." Kessler, who attended last month's briefing, says AMD is still geared for about \$800 million in sales but will probably end up around \$550 million in fiscal 1986, which ends next March.

A year ago, AMD's second-quarter sales hit a record \$257 million, but they have slid since then. In its second quarter, ended Sept. 30, sales dropped to \$128 million from the first quarter's \$151 million. The company posted a net loss of \$15.3 million, versus a profit of \$42.1 million last year. More than half of AMD's \$29.5 million operating loss in the quarter was blamed on poor performance in erasable programmable read-only memories. Sanders has publicly attempted to stop the erosion of EPROM prices by campaigning nationally for U.S. government protection against "predatory pricing from foreign competitors."

Observers think that AMD might have to reverse its no-layoff policy unless a clear upturn is in view by 1986. "After AMD's tremendous growth and capacity buildup, they are sitting way up there in terms of costs," notes Kessler. "They have lost more money on an operating basis than reported on a net basis because they have had a lot of tax credits. But those tax credits are running out."

"It is coming down to a three-tier



AMBITIOUS. AMD's Jerry Sanders wants to be No. 1.

race—an industry turnaround, their tax credits, and whether or not they will cut back the oversized company," he adds.

Sanders believes AMD's sales slump is at last out of the "trough quarter." He expects revenue to start upward despite no significant changes in the new-order rates in recent months. "Something will have to change in the October-to-December quarter, and I believe

the thing to change will be the rate at which AMD produces its new products," Sanders told stockholders gathered in Austin recently for the company's first annual meeting to be held there.

During that meeting, Sanders launched AMD's new-product blitz, known as the "liberty chip" campaign [*Electronics*, Sept. 16, 1985, p. 12]. He compares the chip program to that of

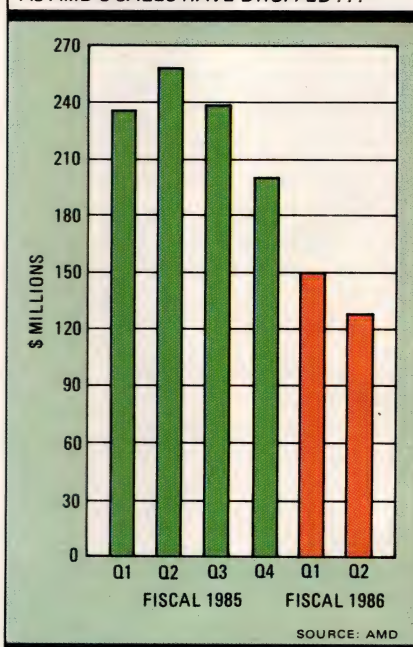
U.S. cargo-ship-building efforts in World War II, in which "liberty ships" were launched as quickly as one a day. Last month, AMD began making available a new product each week for the next year in an attempt to create its own turnaround independent of the market's inertia.

AMD has about 63 new integrated circuits earmarked for introduction over the 52-week campaign. (Sanders considers the extra 11 products as insurance.) Twenty four chips are CMOS, 10 are n-MOS, and 29 will be

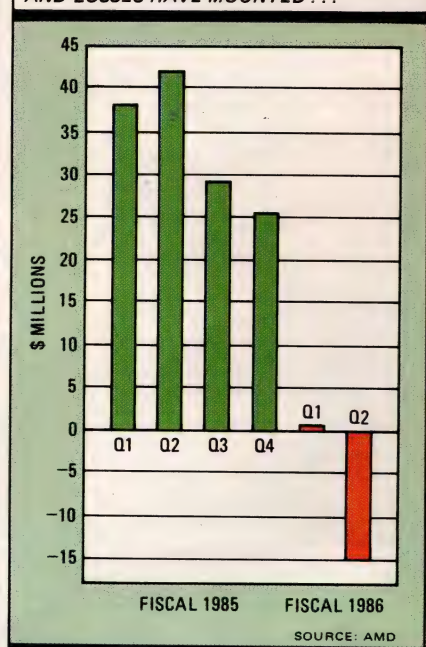
bipolar (table). Of the 63 offerings, 37 are unique ICs and will be available only from AMD.

RECORD R&D. To ensure a steady and available flow of new ICs, AMD has locked research and development expenditures in at about \$45 million per quarter. With revenue now depressed by the market recession, AMD is spending a record 35% of sales on R&D.

AS AMD'S SALES HAVE DROPPED...



AND LOSSES HAVE MOUNTED...



The Texas plants and product engineering groups are preparing for what AMD hopes will be a self-generated recovery. As the company continues to shift volume wafer-fabrication capacity to its new plant sites in central Texas, the Sunnyvale headquarters will focus more attention on R&D, marketing, and administration.

In Austin—where AMD started out six years ago with only 45 employees—the company now has three buildings totaling 679,000 ft². They house 1,650 workers and four MOS lines. Two of the wafer lines are for 6-in. fabrication. The company is also running older 4- and 5-in. lines.

In San Antonio, just south of Austin, AMD has two buildings, totaling 450,000 ft² and housing 530 employees and two bipolar fabs. One of the front ends is believed to be the first 6-in.-wafer fab dedicated to bipolar products. The fab lines are producing AMD's leading-edge IMOX 3-Slot bipolar technology, which has feature sizes as small as 1.2 μ m.

MEETING DEADLINES. Essential for AMD's new-product blitz is the ability to meet tight weekly introduction deadlines and production runs—increasing its dependence on a fully staffed work force. To trim the payroll costs in a depressed market, the company has put its employees on four-day workweeks during some months of the year. It has also issued a 10% pay cut to all salaried workers and a 15% cut for its 100 managers. Pay raises have been deferred. And like many other chip makers, AMD will be closed for two weeks around Christmas and the New Year.

At stake in the long run is the company's goal of becoming the largest U.S.-

based IC supplier by 1990, despite the fact that it fell from its No. 9 position among worldwide chip producers [*Electronics*, Nov. 11, 1985, p. 17]. In addition, AMD wants to be the largest U.S. supplier to growing Japanese system markets. To do that, it is aiming to capture the largest share of worldwide telecommunications-chip markets by 1990.

FOUR-PRONGED. Pivotal to AMD's plans for recovery is a four-pronged thrust into low-power CMOS circuits. AMD is now shipping a 1.4- μ m CMOS 256-K dynamic random-access memory—the Am90C256—to a small selected customer base. A second CMOS effort is focused on a 1-Mb EPROM, the Am-27C1024 [*ElectronicsWeek*, April 22, 1985, p. 52]. A third CMOS program is driven by 64-K high-speed static RAMs. And a fourth involves AMD's CS-11 process, which produces minimum feature sizes of 1.6 μ m. It uses two layers of metal and an advanced planarization technique to deposit narrow interconnection lines atop smooth silicon surfaces.

AMD also continues a limited but essential role in competitive DRAM markets. The DRAM process is considered the base of all other CMOS processes.

Sanders estimates that about half of AMD's business will come from CMOS products in three years. In Austin, the most recently completed 6-in.-wafer fab line will be dedicated totally to CMOS circuits. All new MOS designs are now being implemented in the complementary technologies while CMOS versions of many AMD bipolar products are also in the works. On the bipolar front, AMD is applying the IMOX technology to high-speed emitter-coupled-logic chips.

Sanders doesn't expect more than \$100 million in revenue to result from the fleet of liberty chips during fiscal 1987. However, many industry analysts believe the blitz will improve AMD's position to negotiate new contracts with its traditional second-sourcing partner, Intel Corp.

During the boom years of the early 1980s, AMD aggressively produced and, in some cases, undercut Intel's prices on its widely used 16-bit microprocessors. Such competition is expected to make Intel less willing to deal with AMD in the future. But Intel has yet to line up an alternate source for its new 32-bit 80386 [*Electronics*, Oct. 21, 1985, p. 50], and many observers expect the flotilla of liberty chips—especially the CMOS designs—to become key bargaining chips for AMD. —J. Robert Lineback

BOTTOM LINES

2% OF PLANTS TO GET 65% OF FACTORY CPUs

A handful of factory sites will account for most of the U.S. spending on computers used in manufacturing operations, according to a new study published by the Yankee Group. The Boston market research group says just 2% of manufacturing facilities will account for 65% of the \$4.98 billion that will be spent this year for factory computers. Large plant sites are expected to remain the major buying group as the U.S. manufacturing-computer market grows to \$12.83 billion in 1990. The Yankee Group also notes there is no "typical" user of computers in manufacturing. "The combination of differing business benefits and goals, and varying levels of available capital and human resources has led to widely different rates of adoption and absorption of new manufacturing technology in the U.S.," the report says.

CABOT BUYS CHIP PROCESSOR

In a move to augment its work in crystals, Cabot Corp. has purchased all outstanding shares of Semiconductor Processing Co., a South Boston, Mass., company that slices, laps, etches, and polishes semiconductor materials. Boston-based Cabot has been developing technology for manufacturing gallium arsenide crystals through a research partnership with Crystal Systems Inc. of Salem, Mass., and in-house research at its Billerica, Mass., facility.

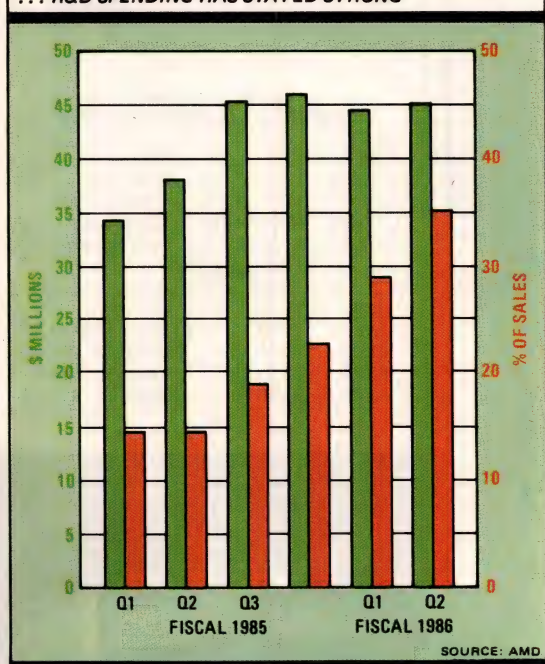
NEC PASSES SHARP IN JAPAN PC RACE

After running neck and neck with Sharp Corp., NEC Corp. has emerged the clear winner in personal computer sales to Japanese businesses and consumers. Apple Computer Inc.'s Macintosh, widely expected to have a major impact in the market, has been received poorly. According to the *Nikkei High Tech Report*, the personal computer market in Japan has lost its former volatility. Higher-priced 16-bit computers are gaining in popularity while sales of low-end products will decline this year.

CORVUS BUYS APPLIED INTELLIGENCE

Corvus Systems Inc., San Jose, Calif., has agreed to acquire all the stock of Applied Intelligence Inc., a privately held developer of PC/NOS, an operating system for local-area networks. Terms were not disclosed.

... R&D SPENDING HAS STAYED STRONG



ENGINEER

A San Diego based firm has immediate openings for system architect/engineer for a fiber-optic-based integrated voice, data, video network. Responsibility includes the design and implementation of all system protocols, hardware, and software. Ten years experience in computer or telephone communication system engineering is required.

We offer unlimited opportunity, combined with unparalleled growth. If you are interested in a generous salary draw plus an industry-competitive benefit package, please send your resume and salary history to:

J. Jaussaud

2111 Palomar Airport Road, Suite 100
Carlsbad, CA 92008

COMPUTER SOFTWARE

SPICE up your PC

Z/SPICE professional circuit simulation
Full version \$245 Student version \$79

ZTEC box 737, college place, wa 99362
(509)-529-7025

POSITIONS VACANT

The Microelectronic Systems Laboratory (MSL) seeks a Lab Development Engineer. The MSL builds digital systems based on our custom VLSI chip designs. Typical projects are highly parallel SIMD/MIMD general and special purpose computing engines. Lab development addresses integration of CAD/CAM/CAT and their associated technologies. Applicants should have command of formal tools and working experience over many technologies, especially electronics, E&M, control systems, transducers, optics, hydrodynamics, thermodynamics, and computer programming. Requirements (equivalents considered): PhD — engineering or a physical science; broad scientific/technological aptitude; capability to rapidly acquire new expertise; 4 years experience including R&D engineering, design and development, strategic technical planning; superior oral and written communications skills. Send application, resume, and names and telephone numbers of three professional references to Ruth Doster, UNC Computer Science Department, New West Hall 035A, Chapel Hill, NC 27514. Applications must be received before 29 November 1985. UNCCH is an AA/EOE.

POSITIONS VACANT

South? Technical/Professional Placement
Network-Fee paid. Murkett Associates, Box 527, Montgomery, AL 36101.

POSITIONS WANTED

Consumer — Controls telecommunication
microprocessor hardware/software, assembly language. Analog, digital design in my N.Y. cab or worldwide. Project rates. Mr. Barry Masel (718) 476-1516.

RESUMES

Resumes — Complete instructions and
examples; \$4, Consultants, Box 567—J, Bergenfield, N.J. 07621.

HOT LINE

To place your
recruitment message

in

Electronics

call Pat Clyne
at

212/512-2557

Advertise your software for only \$114.75

For only \$114.75 per inch you can advertise your software, designed specifically for the electronics industry, to a no-waste audience specifically in need of it—Electronics' paid circulation of 102,000 subscribers.

You'll waste no advertising dollars on waste circulation. These decision-makers need software applications designed specifically for their industry. That's why Electronics' Computer Software Section is a perfect interface because it is programmed to connect you with specific industry interests.

Send your copy/art to the address below. For more information, call Patti Clyne at 212/512-2557.

Electronics Computer Software Section

Post Office Box 900
New York, NY 10020

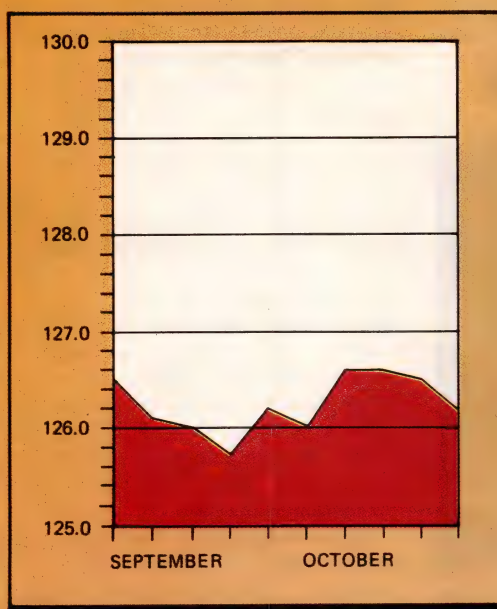


1985 ELECTRONICS COMPUTER SOFTWARE SECTION

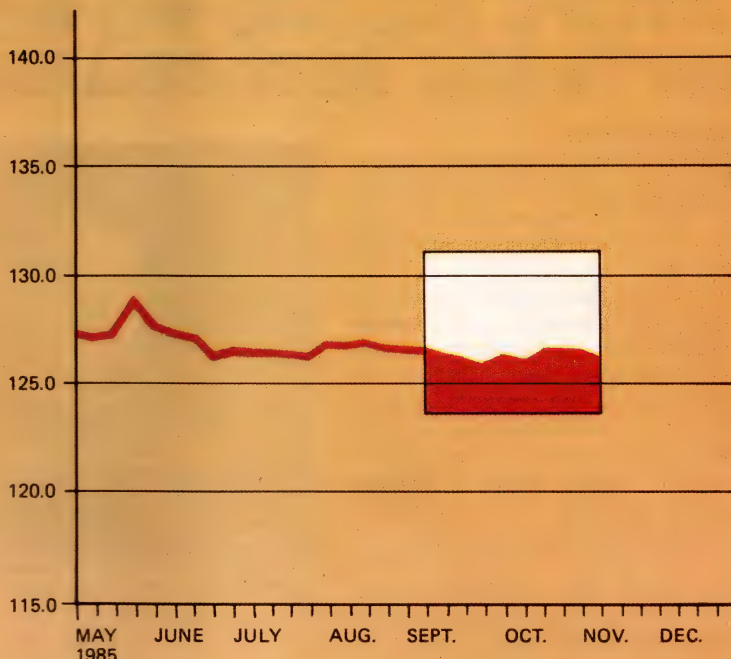
Sizes	Material		
1 Inch	7/8 x 2 1/4	Artwork or	
2 Inch	1 7/8 x 2 1/4	film preferred.	
3 Inch	2 7/8 x 2 1/4	Typesetting	
4 Inch	3 7/8 x 2 1/4	free of charge.	
1985 RATES			
Unit	1X	6X	12X
1 Inch	\$114.75	\$113.75	\$112.80
2 Inch	229.50	227.50	225.60
3 Inch	344.25	341.25	338.40
4 Inch	459.00	455.00	451.20

Call
Patti Clyne
212/512-2557

ELECTRONICS INDEX



THIS WEEK = 126.2
 LAST WEEK = 126.5
 YEAR AGO = 132.2
 1982 = 100.0



The *Electronics Index*, a seasonally adjusted measure of the U.S. electronics industry's health, is a weighted average of various indicators. Different indicators will appear from week to week.

U. S. GENERAL ECONOMIC INDICATORS

	September 1985	August 1985	September 1984
Average prime rate (%)	9.5	9.5	13.0
Retail sales (\$ billions)	120.2	117.0	108.4
Unemployment rate (%)	7.0	6.9	7.2

U. S. ELECTRONICS INDUSTRY EMPLOYMENT

	September 1985	August 1985	September 1984
Production workers (thousands)			
Office and computing machines	173.0	176.9	210.0
Communications equipment	289.0	291.2	286.9
Radio and TV receiving equipment	58.9	58.4	65.0
Components	355.1	358.5	416.2

September was another rough month in the electronics industry, and manufacturers trimmed another 9,000 jobs from their payrolls. That brought industry employment down more than 100,000 from a year ago. It also caused the *Electronics Index* to tumble 0.2% in the latest week, bringing it down 4.5% from its level a year ago.

The only sector to increase employment in September was radio and TV, where the gain was a mere 500 workers. Meanwhile, large employers were scaling back: makers of office equipment cut employment sharply, by 2.2%. And communications-equipment and components companies reduced payrolls by 0.8% and 0.9%, respectively.

As if this wasn't a glum enough picture, the near future shows signs of holding more of the same. For example, IBM

Corp. is deferring, and Control Data Corp. is cutting back, capital-spending plans. And a new McGraw-Hill Economics capital-spending survey dug up some bad news for communications-equipment makers: telephone and other communications-services companies plan to reduce plant and equipment purchases in 1986, after adjusting for inflation. In fact, the survey found that industry as a whole plans to cut capital investment next year—a bad omen for sales of computers and other electronic equipment.

With a 2.7% surge in retail sales for the month, the general economic indicators may seem encouraging at first glance. But that gain came from automakers' cut-rate financing deals. What the data doesn't show is how deeply in debt consumers have gone to buy cars and other goods.

LOTUS'S BELOVE: 'NO MORE SOFTWARE BEST-SELLERS'

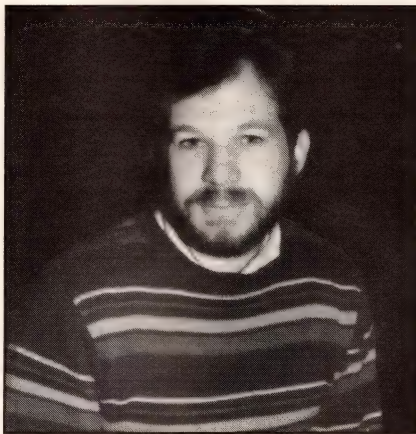
CAMBRIDGE, MASS.

Edward J. Belove remembers saying, "Nobody will ever knock off VisiCalc." That was way back in the early days of personal computer software—about 1981.

Of course, that best-seller—and the company that developed it—are now ancient history. But the perspective should come in handy for Belove, 35, who was recently named vice president of corporate research and development at Lotus Development Corp. The company is currently the volume leader in personal computer software.

Belove arrived at Lotus in May as director of advanced product development, moving over from Microcom Inc., where he was also responsible for advanced R&D. Before that, he worked for eight years at Data General Corp., holding a variety of titles including director of advanced product development. Belove holds an AB in applied mathematics, which he received in 1972 from Harvard University.

CATCHALL. At Lotus, corporate R&D encompasses long-range efforts and projects that fall between divisional cracks. The work is best characterized as advanced development, says Belove, and also involves coordinating product devel-



LOTUS'S BELOVE: "There isn't going to be 'the next Lotus 1-2-3.'"

opment across divisions and counseling top management on R&D strategy.

Belove bases much of his thinking on the future he sees for Intel Corp.'s 8088 chip, the engine of the plain-vanilla IBM Personal Computer. "The 8088 will be here for a long time," he contends. This is partly because falling prices will keep 8088 products competitive and partly because the chip does the job required. "There's a whole class of users that's not limited by the [IBM] PC," he says.

Although the basic machines may have a solid future, Belove is less sanguine about the likelihood of future software best-sellers. "There isn't going to be 'the next Lotus 1-2-3,'" he insists. What will come in its place is something that is more tailored to a market segment but still general enough to attract a moderately sized audience. Belove believes that more powerful tools require greater specificity and focus on a market segment. "As the overall market grows, you can afford to do that," he says.

DEVELOPMENT OPTIONS. In further developing that specialized software, Lotus confronts two options, says Belove. Either the objective will be greater functionality at the same level of user complexity, or maintaining the level of functionality and making the product easier for customers to use.

Natural language is the area of particular concentration for improving accessibility. "That's the place where we can get the most improvement," according to Belove. "Lotus 1-2-3 has a lot of power in there that even sophisticated users don't use."

Belove thinks word processing is particularly ripe for functionality improvements. In the next year, he says, Lotus will introduce products that will let people deal with text at a level above that of existing word-processing software. These products address word-processing issues both within a single document and in dealing with sets of documents. —Craig D. Rose

PEOPLE ON THE MOVE

GARY E. LIEBL

□ Joining Cipher Data Products Inc. as president and chief operating officer, Gary E. Liebl will manage all the San Diego company's departments except finance and business development, which continue to report to chairman Don M. Muller. Liebl previously was operating officer for McDonnell Douglas Corp.'s \$1.2 billion Information Systems Group and president of minicomputer company Microdata Corp., Irvine, Calif., when it was acquired by McDonnell Douglas.

ANTHONY F. GRIFFITHS

□ Mitel Inc., the telecommunications equipment and semiconductor manufacturer based in Boca Raton, Fla., has completed a senior management shuffle with the naming of Anthony F. Grif-

fiths as its new president and chief executive officer. He replaces Mitel cofounder Terence H. Matthews, who will become chairman of the board of directors. Griffiths, 55, served on Mitel's board during the last year while working for the investment management house Connor, Clark & Co. Ltd., Toronto. As chairman, Matthews, 42, says he will now focus on marketing activities and initiating strategic new-product ventures. Mitel, which specializes in private branch exchanges for voice and data, recently introduced a large-line (more than 400 lines) switching system that will allow Mitel to compete with large telecommunications companies.

W. SCOTT WALKER

□ W. Scott Walker, a group vice president, has moved into a newly created post at Hughes Aircraft Co.'s Indus-

trial Electronics Group, managing consolidated microelectronic operations. The operations cluster three formerly separate semiconductor divisions in order to intensify development of next-generation device technology, the company says. Walker previously managed the Solid State Products Division, Newport Beach, Calif., where the new group operation is based, along with the new Semiconductor Division.

DANIEL BRICKLIN

□ A successful pioneer of personal computer software, Daniel Bricklin is back working at home and launching a startup. Bricklin codeveloped VisiCalc, which became personal computing's first big software seller, only to see his company, Software Arts, hit the skids when it failed to develop a successful followup and also got bogged down in

litigation. Its assets were eventually bought by Lotus Development Corp., where for a time Bricklin was a consultant. Now he's launched Software Garden Inc., a one-man operation, whose first offering is an \$80 software prototyping product.

JAMES POMPA

□ James Pompa succeeds Kenneth Fisher as president of Encore Computer Corp., Marlboro, Mass. Pompa moves to the company after 15 years at Honeywell Information Systems Inc., Minneapolis, where he served most recently as a senior vice president of marketing. Pompa says he made the move because he believes in the future of Encore's multiprocessor architecture. "This is not a good time to sell computers, but there's enough of a market out there to accommodate our plans."

PHILIPS ECG CHIEF IS AN ENGINEER...AND A WOMAN

SENECA FALLS, N. Y.

As far as I know, I'm the only top engineering woman in our business in the world," declares Iva Wilson, vice president of engineering for Philips ECG Inc. But being a woman in an overwhelmingly male field has never held back Wilson, who will become president of the maker of color cathode-ray tubes in February.

Wilson, a native of Zagreb, Yugoslavia, is a determined engineer and manager who has taken advantage of every opportunity to come her way. She has never worried about her career path. "You have to stop worrying that there are males dominating the field. You have to work to the best of your abilities and you will get there."

Since she joined Philips, she and A. John Torre—who will retire as president on Jan. 31—have cut the average age of the engineering staff by three years, consolidated production into one facility, halving production costs, and have now begun an ambitious plan to automate the manufacturing process with a capital improvement program worth \$10 million to \$12 million over the next five years—exclusive of new products. When those figures are added in, that number doubles, Wilson says. "You have to do those things to be a technology leader, and you have to be a leader to be the best."

Professional women were not uncommon during Wilson's childhood. As a child in post-war Eastern Europe, Wilson was surrounded by professional women because so many men were killed during World War II. Her mother was a lawyer and raised her single-handedly after Wilson's father died in the war. Her gender became an issue only when she immigrated to the U.S. in 1968 at the age of 30.

Wilson quickly established herself as an authority in electron optics at the Rauland Division of Zenith Radio Corp. She holds a patent on an electron-gun optics system developed after she got her first taste of management in 1976 as the leader of a product-development team. Soon after, she was appointed manager of product engineering.

Learning management was difficult because her educational background fell short in three areas: economics, finance, and management, she says. While still with Zenith, she began work toward an MBA from the University of Chicago; for two years she attended classes on alternate Fridays or Saturdays while



PHILIPS ECG's WILSON: the only top engineering woman in the business?

maintaining her job and family obligations—she has a daughter, now 12, and a husband. When she took the Philips ECG job, she finished her final quarter by commuting to Chicago on a weekly basis.

Wilson, who has a doctorate in electrical engineering from the University of Stuttgart in West Germany and an undergraduate degree from the University of Zagreb, joined Philips ECG in her present post in 1983. She followed Torre from her previous post at Zenith, but it was with neither the desire nor the expectation to lead the company, she says.

"As a matter of fact, it was quite the opposite," she says. Torre made it clear to her that even though he planned to retire in early 1986, there was no connection between the post she was taking and the company presidency.

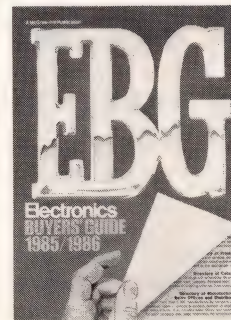
MAKING CHANGES. When Wilson arrived at Philips ECG, her work was cut out for her. The company had been a largely ignored division of GTE Sylvania when Philips, the Netherlands, acquired it in 1981, and its engineering staff had grown uninspired before its time.

As the new vice president, Wilson instituted an open-door policy to encourage interaction between the engineers and their managers, helped put together a retirement incentive plan so the company could hire younger talent, and established a policy aimed at fitting people into the jobs that they were most suited for. It was a difficult task because not everyone agreed with her impressions of what they were best able to do. "We revived the organization and brought in new blood."

—Tobias Naegel

AVAILABLE!

1985-86
**Electronics
Buyers' Guide**



Order your copy today for the industry's most often-used directory:

- It's three directories in one
- Includes more than 4,000 product listings. (approx. 700 pages)
- Contains over 5,000 company listings (approx. 400 pages) including:
 - Company name, address and phone number.
 - Name and title of contact for sales information.
 - Number of engineers at plant and number of employees.
 - Annual dollar sales volume.
 - Local sales offices and manufacturers representatives.
 - Local distributors.
 - Instant referral to company's advertisements.
- Offers FREE current catalog retrieval service (approx. 1300 catalogs)

Price: \$40 USA & Canada
\$50 elsewhere
(add \$30 for airmail)

Send order with payment to:
Regina Hera

Electronics Buyers' Guide
1221 Avenue of the Americas
New York, NY 10020



NEW PRODUCTS

TOUCH-SENSITIVE PANEL WORKS WITH CRT, EL, PLASMA DISPLAYS

GLASS PANEL COSTS LESS THAN PLASTIC AND ELIMINATES DISTORTION

Tektronix is stepping up its drive to sell to other manufacturers the technologies that it developed originally for in-house use. The company is now offering an interactive touch-sensitive panel for CRT displays. The new panel can also be used to convert electroluminescent and gas-plasma displays into touch-sensitive screens.

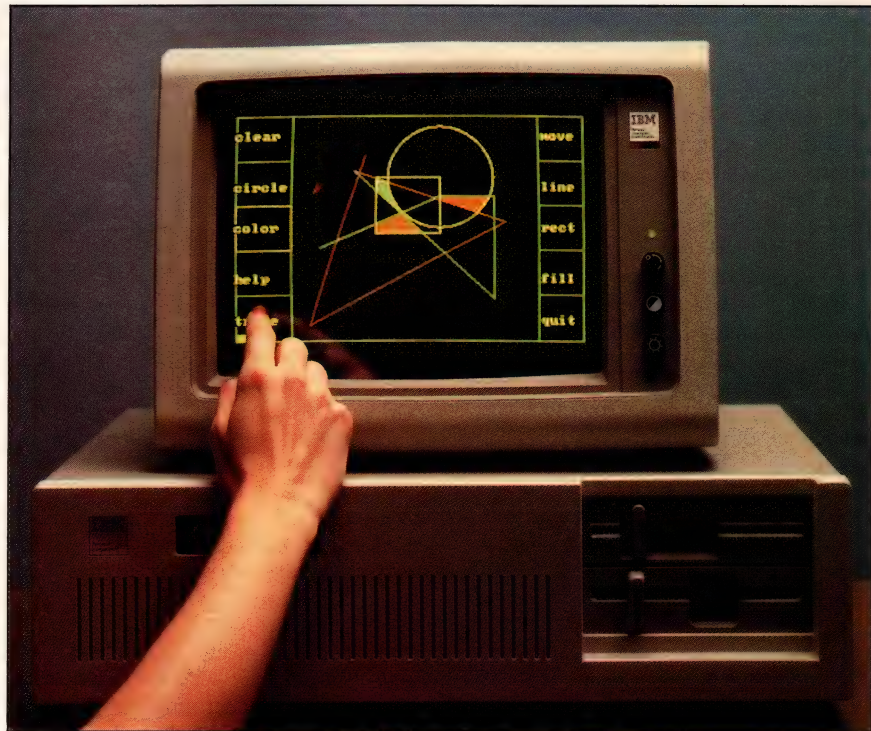
Based on a transparent, resistive, continuous-film technology, the TekTouch panel is a "very tough deposition" on a glass, according to Victor Pastore, the product's marketing manager. The resistive film is put on the glass using a vacuum deposition process. The company will not describe the resistive film in detail or disclose the screen's resolution.

TekTouch has two basic advantages over other panels that have been on the market for some years now, Pastore claims. First, the deposition is very durable, so the panel will easily last the lifetime of any monitor it is attached to. Second, the film is deposited directly onto glass, so it is not subject to the problems of visual distortion and warpage found in plastic screen covers.

EASY INSTALLATION. Tektronix says producing the glass panel is less expensive than producing a plastic panel. Further, the cost of installing a glass panel is lower than that of installing the plastic because there is an inherently more involved installation process to mount the plastic correctly. As to the fragility of the glass, manufacturers should have no more trouble with it than they experience working with the glass faceplates used on display devices.

By accepting inputs directly from the screen, TekTouch can eliminate entirely the need for additional keyboard space to accommodate special function keys for some applications. This is because reprogrammable soft keys can be formed directly on the panel. Users can perform simple functions such as menu or multiple-choice selection without directing their attention away from the screen to corresponding input devices, such as switches or keyboards.

TekTouch suits environments in which



FLEXIBLE. Tektronix's touch-sensitive panel even works with gas-plasma and EL displays.

concern over particulate contamination is important, since the panel's resistivity enables users to operate it while wearing some types of gloves. The panel can be activated by users wearing most thin gloves—such as those used in clean rooms and hospitals—but users wearing heavy gloves—like those worn for pro-

tection from extreme temperatures—cannot activate the panel.

Though glass does not offer the flexibility of plastic, the company designed the panel so that only a 0.13-in. perpendicular clearance to the existing display surface is necessary. Because there is often that much clearance between a screen and the bezel holding it, Pastore claims that most manufacturers will not have to reengineer and retool their production lines before adding the TekTouch panel to their products.

Applications for the panel are far-ranging. In mass markets, the panel could find use in automatic teller machines and in automobile dashboards. In more specialized uses, the panel can serve medical monitoring equipment or military command and control systems. Pastore says the screen "will certainly find a place in the industrial market." The company already plans to incorporate it into a soon-to-be-introduced in-



If the pulse of the electronics business can be measured by the number and quality of the products introduced at one of its premiere trade shows, then the prognosis is good for the industry. The following six pages showcase 10 of the important products bowing at this week's Wescon show in San Francisco, which should draw at least 80,000 people to view the offerings of 933 exhibitors.

strument. A similar version was used on two of Tektronix' logic analyzers.

The driver electronics consist of standard components that are housed on a conventional 4-by-5-in. pc board. That space could be reduced with the design of a specially designed hybrid circuit.

Prototypes, which include electronics, are now available in sizes from a little more than 2 to 13 in. diagonally measured. Prototypes of up to 13 in. sell for \$800 each; shipping is within six weeks of order. Tektronix can also make pan-

els up to 25-in. diagonal and with height-to-width ratios of 1:4.

With the TekTouch, Tektronix' Display Devices Operation is looking for original-equipment-manufacturer relationships with other instrument, CRT, and display-monitor makers—in addition to supplying the panel for use in Tektronix products.

—Eve Bennett

Tektronix Inc., Display Devices Operation, P.O. Box 500, M/S 46-539, Beaverton, Ore. 97077. Phone (503) 627-6583 [Circle reader service number 401]

WAVEFORM PROCESSING ENHANCES LECROY SCOPE

An enhancement to LeCroy's model 9400 digital storage oscilloscope, which got a warm reception when it was introduced earlier this year, should make it even more popular. The WPO1 waveform-processing package provides such features as summation averaging, continuous averaging, arithmetic processing of waveforms, and a number of digital filtering techniques.

The model 9400, which boasts a 5-gigasample/s random interleaved sampling rate and has a 125-MHz bandwidth, features 32-K-words by 8-bit waveform memory and 100-megasample/s analog-to-digital converters on each of the scope's two channels [*ElectronicsWeek*, April 22, 1985, p. 64].

The summation-averaging feature averages up to 1 million sweeps on both channels at rates of 100,000 points/s. With the feature, which takes place in a 32-bit structure, it is possible to dither the offset value of the input signal by fractions of a least significant bit. Dithering increases the resolution of the ADC processing from the scope's 8 bits to about 10 or 12 bits, depending on signal and noise conditions. Averaging also allows the user to reject signals

that are beyond the dynamic range of the converter.

Continuous averaging provides a quick and convenient method of reducing noise in measurement signals while they are displayed. An infinite number of waveforms can be averaged, each weighted between 1 and 128.

Long-term drift and glitches can be identified with the Extrema mode. The

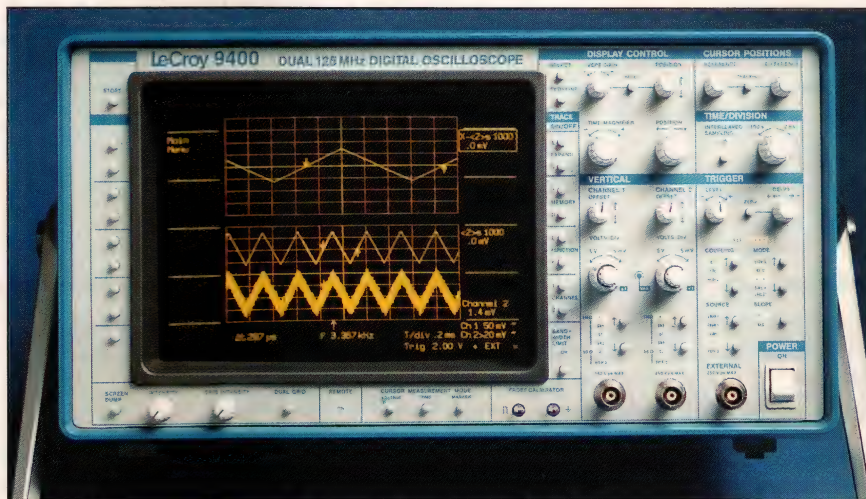
mode records and displays all the extreme positive and negative values, even as short as 10 ns. Thus, the user can detect all signals that drift in time, frequency, or amplitude, or that contain spikes and glitches.

FIVE FILTERS. The WPO1 package provides five types of digital filtering to reduce noise on single-shot events. The package offers a 3-, 5-, 7-, or 9-point filter. Other arithmetic processing features include multiplying, dividing, adding, subtracting, and squaring stored and incoming signals. With this feature, users can multiply channel 1 (voltage) and channel 2 (current) to display the resulting power signal.

Users of the model 9400 can return the scope to one of LeCroy's service centers for installation of the software package, which costs \$2,000. The software comes on a card with 512-K words of additional memory that is installed in the scope's spare slot. New customers can order the software package as an option to the 9400, which sells for \$13,700.

—Steve Zollo

LeCroy Research Systems Corp., 700 S. Main St., Spring Valley, N.Y. 10977. Phone (914) 425-2000 [Circle 410]



DITHERING. The WPO1 software lets users raise the conversion accuracy of LeCroy's scope.

CARD TURNS IBM PC INTO BUS ANALYZER

An IEEE-488 bus-analyzer card from National Instruments Corp. plugs into an expansion slot in any of the Personal Computers from IBM Corp., expanding the PC's versatile role as an engineering tool chest.

"The PC is now thought of as a 'motherboard' of sorts. People plug tools into it to perform different engineering tasks," notes Donald Nadon, vice president of sales and marketing.

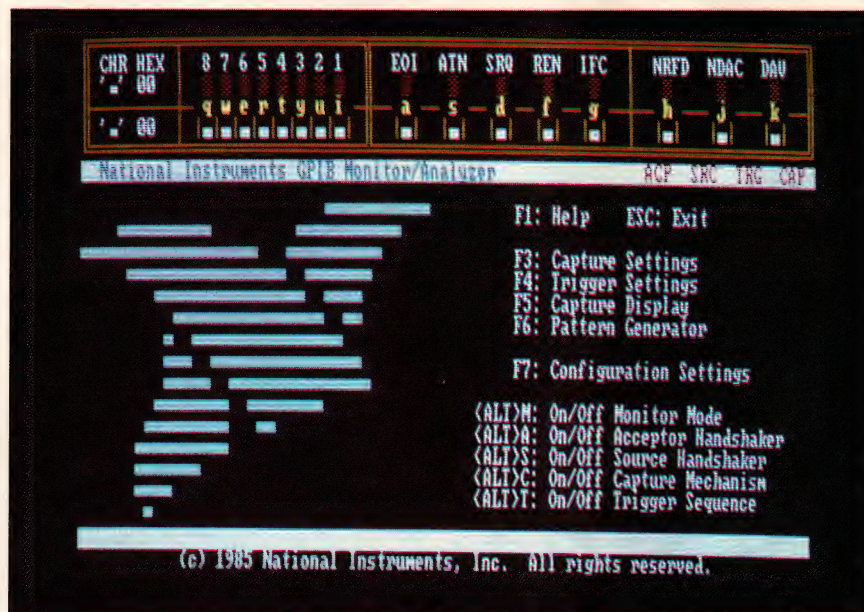
The GPIB-410 and software enable us-

ers of IBM PCs to automatically record bus-performance information in main memory or mass storage. With the package, users can analyze bus transactions and performance parameters through a number of menu-driven color displays.

The new board and software allow computers to double as bus analyzers. A functionally equivalent dedicated analyzer would cost about \$5,000, estimates Nadon. National Instruments' GPIB-410 is available at a special introductory

price of \$495, and it will sell for \$995 in January. Deliveries begin this month.

The bus analyzer lets the IBM PC record transactions on IEEE-488 links—both control and data lines. Users can set the system to capture performance data from a variety of trigger points, including an internal clock or an external source. The analyzer examines the 488 bus by varying the clock speed for data I/O. The GPIB-410 has a pattern-generating feature, auto-talker, which



CODED. National Instruments' bus analyzer uses the IBM PC's color display to highlight data.

allows designers or those involved in debugging IEEE-488-bus applications to place data and control-line patterns interactively on the link. For intermittent problems, the analyzer will generate patterns and record events 1 byte at a time in memory.

Users can then view bus performance on the display, showing data on either side of selected trigger points. The software supports a variety of sequences that simulate bus operating conditions.

"You can establish a specific reference, or trigger point, related to a particular pattern or speed," Nadon says. "The analyzer monitors all data travel-

ing across the bus but stores information when it matches these trigger-point patterns. You don't always want to scan through three days' worth of data."

One common problem faced by IEEE-488 users is known as "bus hang," in which all devices attached to the parallel bus are placed on hold, waiting for each other to begin talking on the link. Several bytes of data transmitted just prior to bus hang can be useful in pinpointing the problem. —J. Robert Lineback

National Instruments Corp., 12109 Technology Blvd., Austin, Texas 78727.
Phone (512) 250-9119 [Circle 407]

TESTERS SIMPLIFY DESIGN OF VMEBUS SYSTEMS

Two new items from Dawn VME Products Inc. will simplify the VMEbus-system designer's job. The Dawn Technology Inc. subsidiary is adding a backplane tester and an extender-board tester, plus a line of high-performance memory boards, to its VMEbus-product line.

The system runs on an IBM Personal Computer. And though it's called the VMETSTR, it can test both VMEbus and Multibus products. For \$9,995 in single quantities, the system includes applications software and an instruction manual on a 5¼-in. disk, a set of VMEbus test modules with ribbon cable and connector, and an interface board that plugs into the PC host system.

"It's the ultimate answer to testing backplanes and extender boards,"

claims company spokesman Rick Rodrigues. "In 30 seconds, it can print out a complete pin grid array of where a short-circuit might occur, then explain troubleshooting in either technical or layman's terms."

VMETSTR offers analog testing for shorts, continuity, and correct termination values, and identifies defective, improperly installed, and out-of-tolerance terminations. Modules are available to test the backplane either on the bench or in the system. Software is menu-driven, and the hard-copy printout for each backplane tested shows each one's unique information, including part number, serial number, and whether the board passed or failed.

If the equipment fails, the printout also includes a "failing pin map" and

analysis of the exact problem, such as "net shorted to ground" or "net shorted to +5 V." Such pinpointing streamlines the repair/return/rework process, says Rodrigues. "We decided to release this product to the industry for the first time, so companies could test their own equipment."

Dawn VME Products is also unveiling a new line of high-performance dynamic RAM boards for 16- and 32-bit systems, Rodrigues reports. The boards can be modified from the 3U form factor to the 6U, although they come standard with 3U. The DRAM card remains the same, but the front panel can be interchanged for different systems.

Boards will be available in 1-megabyte, 2-megabyte, and, eventually, 4-megabyte sizes. All meet VMEbus revision-C specifications. Prices are \$890 for the 1-megabyte version and \$1,295 for the 2-megabyte model; the 4-megabyte board for Digital Equipment Corp.'s systems will sell for \$2,500.

—Denise Caruso

Dawn VME Products Inc., 2405 De La Cruz Blvd., Santa Clara, Calif. 95050.
Phone (408) 980-1124 [Circle 403]

AC CALIBRATOR IS FULLY AUTOMATIC

Ballantine Laboratories thinks it's licked the laborious, time-consuming process of calibrating and certifying programmable ac voltage calibrators. The company is offering a fully automatic system based on IBM Corp.'s Personal Computer.

The Computest Type 4060E work-station cluster, the latest in a series of PC-driven metrology systems from Ballantine, uses IBM's PC to drive a precision transfer standard and the ac voltage calibrator being tested in a closed-loop IEEE-488 system. All National Bureau of Standards traceable ac/dc correction factors are implemented in software for absolute calibration, according to the company.

The 4060E can program bus-programmable ac-calibration sources 5 to 10 times faster than conventional systems. The unit can operate at a faster rate thanks to a menu-driven software program that makes many of the individual steps in the calibration process transparent to the user, as it ensures accuracy to within 20 parts/min.

Designed for rapid multipoint calibration of products from Fluke, Rotek, and Datron, the 4060E typically calibrates at about one point/min. A cali-



SOFTWARE. Ballantine's software includes all NBS correction factors for absolute calibration.

bration certificate is automatically printed out upon completion of the procedure. The system, which can be used in a mobile configuration for factory floors or as a bench cluster for primary standards lab use, offers users the option of choosing an arithmetically derived worst-case error calculation or an algebraic error calculation that takes the square root of the sum of the squares of two error sources to gain its result.

Three configurations are available: the basic 4060E, the 4060E-MOD 65, and the 40601E. The 4060E is a turnkey system that includes a PC with an IEEE-488 bus interface and RAM that acts like a disk drive to hold the intermediate measurement data, which frees a disk drive on the PC for data recording; a high-speed dot-matrix printer; a color display; and two products developed by

Ballantine—the 1605A programmable ac/dc transfer standard, and the 40601E software package. The MOD 65 version comes without the computer and the 40601E is just the software. In all cases, the user must add a 6½-digit programmable dc voltmeter.

The 1650A transfer standard handles frequencies ranging between 10 Hz and 100 MHz and voltages from 225 mV to 1.1 kV. The basic ac-to-dc transfer uncertainty is within 30 ppm, but correction routines built into the software can be used to cut that to 20 ppm.

The turnkey system costs \$19,995 and is available in 30 to 60 days. The MOD 65 version is \$14,995 and the software alone costs \$3,500. —Tobias Naegel

Ballantine Laboratories Inc., P.O. Box 97, Boonton, N.J. 07005.
Phone (201) 335-0900 [Circle 409]

They suit such high-power, high-speed applications as switching power supplies and regulators, motor controls, relay and solenoid drivers, and high-energy pulse circuits, the company says.

The parts are available in either plastic TO-220 packages or in metal TO-204AA or TO-204AE packages, depending on current rating. They come in voltage ratings up to 200 V, current ratings up to 40 A, and power ratings up to 150 W. They can dissipate up to 25% more power than competitors' parts, the company says.

These parts have a lower on-resistance rating than do parts of comparable voltage or comparable power dissipation, says Ralph Locher, manager of applications engineering. The on-resistance rating at a case temperature of 25°C is 0.055 Ω for the 40-A series and 0.35 Ω for the 10-A series. The 29-A series has the lowest rating at 0.11 Ω . The parts give "a circuit designer a little more power control for his money," Locher says.

—Eve Bennett

Fairchild Camera & Instrument Corp., Power Systems Division, 4300 Redwood Hwy., San Rafael, Calif. 94903.
Phone (415) 499-4406 [Circle 402]

LOW-PRICE SCOPE HAS SWEEP DELAY

Beckman Industrial's 9020 analog oscilloscope has features usually found only on more expensive, higher-performance models. The portable addition to Beckman's line of 20-MHz scopes weighs under 20 lb, sells for \$495, and will be available in January.

"Its major added features include a built-in sweep delay and component tester," according to Patrick Chu, Beckman's product manager. "This combination and its low price should make it appeal to field-service engineers, hobbyists, and students."

PUSHBUTTON INVERSION. The 9020's display capabilities include dual-trace display of both channel 1 and channel 2 simultaneously. If a temporary blackout on one of the channels is needed, the oscilloscope can display only one channel. It adds and subtracts waveforms and can invert them by pushing a button. "It's a convenience feature," Chu explains. "This hold-off feature maintains an easy-to-read, stable display. These features aren't new, but you usually don't find them on a 20-MHz scope."

The scope has a maximum sweep speed of 50 ns/division and a sensitivity of 1 mV/division. Its 6-in. CRT displays

FAIRCHILD EXPANDS POWER MOS FET LINE

The power MOS FET market keeps beckoning to Fairchild Camera & Instrument. Just six months after the company entered the market with a line of high-voltage parts, its Power System

Division is introducing a medium-voltage family.

The enhancement-mode FETs are fabricated in n-channel double-density CMOS, which the company calls DMOS.

FAIRCHILD UNVEILS MEDIUM-POWER MOS FETs

Model	Operating supply (V)	Current (A)	Power (W)	Price
IRF 150-153	60, 100	40	150	\$10 to \$18
IRF 250-253	150, 200	30	150	\$13 to \$18
IRF 140-143/540-543, MTP 20N08/10	60, 100	29	125, 150	\$5 to \$8
IRF 130-133/530-533	60, 100	20	75, 100	\$2 to \$3.50
IRF 240-243/640-643	150, 200	20	125, 150	\$5 to \$8
IRF 230-233/630-633	150, 200	10	75, 100	\$2 to \$3

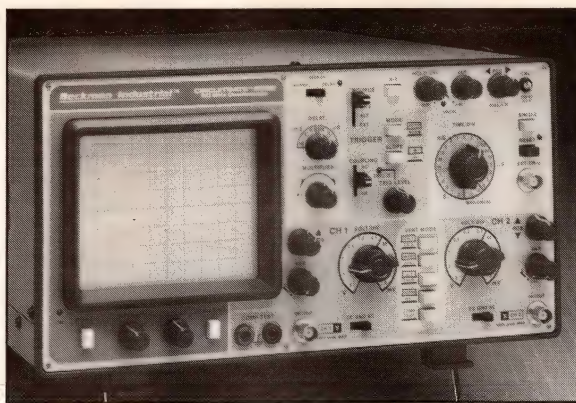
channel 1 only (normal or inverted), channel 2 only, alternate, chop, or channel 1 plus channel 2.

Alternate mode, a dual-channel operation in which channel 1 and channel 2 are swept alternately, makes the scope suitable for observation with fast sweep speed. The chop mode operates between two channels, chopped at a preset frequency of about 500 kHz. It makes the scope suitable for observation with slow sweep speed.

Among vertical differentiation specifications is a bandwidth of up to 20 MHz (-3 dB) accurate to $\pm 3\%$ over a temperature range of 10°C to 35°C . The scope's maximum input voltage is 400 V (dc plus peak ac).

For time-base deflection, the scope has 20 calibrated steps, from $0.1 \mu\text{s}/\text{division}$ to $0.2 \text{ s}/\text{division}$. For sweep delay, which makes taking time measurements easier, ranges have six preset steps, ranging from $0.1 \mu\text{s}$ to 10 ms.

On internal triggering, the 9020 scope's sensitivity is $0.5 \text{ V}/\text{division}$



LOW-END. Beckman's low-end 20-MHz scope packs features more often found in higher-performance models.

(from 20 Hz to 20 MHz); with external triggering, its sensitivity is $0.5 \text{ V}/\text{division}$ at a minimum.

The CRT has a 150-mm rectangular screen with 8-by-10 division internal graticule and about 2-kV acceleration potential.

The 9020 portable oscilloscope will come with an operation manual and two test probes.

—Ellie Aguilar

Beckman Industrial Corp., 630 Puente St., Brea, Calif. 92621.

Phone (714) 671-4800

[Circle 406]

MOTOROLA PROCESSOR CARRIES EEPROM ON CHIP

Motorola Inc. is adding three new 8-bit ICs to its single-chip CMOS microcomputer family as part of an aggressive portfolio expansion in the single-chip microcontroller arena. One microprocessor retains programs and data in 2-K bytes of alterable nonvolatile memory, another is twice as fast as its predecessor, and a third can hold 8-K bytes of masked software.

"We are starting to get a lot of attention for these kind of parts in the telecommunications market, where one can actually change the setting of the EEPROM-based microcomputers over phone lines using the SCI [serial communications interface]," notes Wade Wyatt, manager of technical marketing in Austin, Texas.

The MC68HC811A2 features 2-K bytes of 5-V EEPROM, in addition to several on-board peripheral functions. The high-speed CMOS part also has 256 bytes of RAM, an enhanced 16-bit timer system with three input captures and five output-compare functions, and 8-bit pulse accumulator.

The MC68HC811A2 contains an asynchronous serial communications inter-

face, a synchronous serial peripheral interface (SPI), an 8-channel, 8-bit analog-to-digital converter, parallel handshake ports, a boot-loading ROM, and real-time interrupt circuitry. As part of Motorola's HC11 family, the 68HC811A2 employs an enhanced instruction set—add-

ing 88 new codes to the standard software for the older M6801. It also has a 16-by-16-bit divide and a bit-manipulation instruction.

In quantities of 1,000, the 68HC811A2 sells for \$125 each. The chip will be available for sampling in the first quarter of next year. In the second half of 1986, Motorola expects to cut prices as volumes build. The microcontroller will be packaged in a 40-pin DIP or a 52-lead plastic chip-carrier.

The MC68HSC05C4 brings new speed to Motorola's 8-bit microcomputer by operating at 4.2 MHz, twice the internal bus frequency as the existing 2.1-MHz 68HC05C4. Like the older part, the speedy new microcomputer contains 4,160 bytes of user ROM, 176 bytes of RAM, 24 bidirectional I/O lines, an internal 16-bit timer with input capture and output compare functions, an asynchronous SCI, a synchronous SPI, and two power-saving modes of wait and stop. It employs the enhanced set of M6805 instructions, including an 8-by-8-bit multiplication instruction.

MORE ROM. For applications needing higher-capacity ROM storage, the new MC68HC05C8 offers 7,744 bytes of masked memory, plus all the functional blocks on the 68HSC05C4. The 8-K ROM part operates at the standard 2.1-MHz internal bus speed.

Both the fast 68HSC05C4 and the 68HC05C8 sell for \$7 to \$8 each in high-volume production quantities. Because they are ROM-based parts, the usual minimum order is 5,000 pieces. Both are available now and are housed in either 40-pin DIPs or 44-pin plastic J-leaded chip carriers.

—J. Robert Lineback

Motorola Inc., Microcomputer Operations, 6501 William Cannon Dr. W., Austin, Texas 75735. Phone (512) 440-2990 [Circle 408]

PROM PROGRAMMER IS FOUR TIMES FASTER

Data I/O has attained up to a four-fold improvement in throughput on its new family of parallel PROM programmers through use of improved electronics, mathematics, mechanics, and software. The Series 1000 is designed for medium- to high-volume production—over 1,200 parts per hour.

The series improves throughput by speeding the programming process, reducing setup and operation time, and minimizing downtime. The means to these ends include the use of the 8-MHz version of the Intel 80188 microprocessor for programming, implementing test

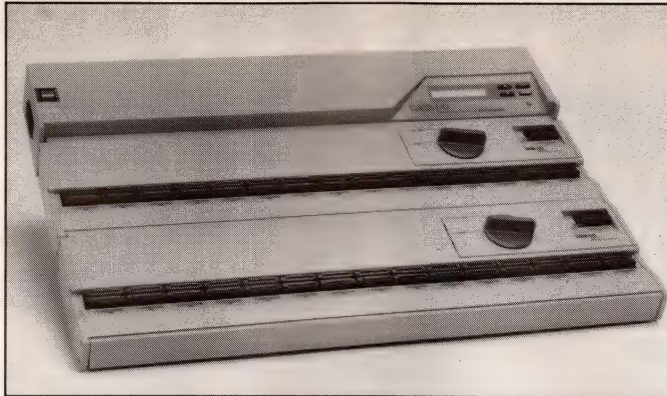
and verification procedures in hardware, and supporting the newer high-speed programming algorithms. Loading the system is faster because up to 30 devices can slide directly into sockets and be programmed at one time.

Data I/O has enhanced reliability with such features as socket isolation, self-calibration of programming and supply voltages, sophisticated diagnostics, and safe power-down procedures after failures. The fast test and verification hardware also reduce programming overhead. The company supplies firmware for over 200 common programming al-

gorithms, including the Intel Quick Pulse, which programs at 100 μ s/byte, compared with 1 to 4 ms/byte for most standard algorithms.

The advances are necessary to meet the programming demands of new devices and packages, the company claims. The 1-Mb chips are already appearing in 40-pin packages, and denser devices are on the way.

The Series 1000 supports n-MOS and CMOS one-time programmable ROMs, EPROMs, and EEPROMs, and micro-controllers with EPROM on chip. It can handle up to thirty 24- or 28-pin devices simultaneously, or up to twenty 32- or 40-pin devices. Removable socket rails make it possible to adapt the programmers to new device and package types as they emerge.



FASTER. Data I/O achieved a fourfold increase in the throughput of its programmers by cutting both the programming time and setup time.

Data I/O supplies the Series 1000 in three configurations. The basic 1010 system is a simple duplicator that works only from a master device. Addition of a memory board with 1 megabyte of RAM and RS-232-C and IEEE-488 interfaces

turns the duplicator into the 1020 downloader, which can accept patterns from a remote computer.

With an interface kit consisting of an IBM Corp. Personal Computer expansion board and software, users can operate the programmer from menus on the PC's screen. In this model, the 1030 virtual-memory programmer, the PC's disk storage can be used as an extension of programming RAM, with no practical limit to the size of data files.

The first member of the series, the 1010, will be available in December for about \$5,000.

Data I/O Corp., 10525 Willows Road N. E., Redmond, Wash. 98073.
Phone (206) 881-6444 [Circle 405]

LOGIC ANALYZERS COVER THE SPECTRUM

Gould's Design and Test Systems Division is going back to its roots: logic analysis. And the company is doing it in a big way with six logic analyzers that range from lightweight portables to high-speed benchtop computer-aided-engineering and design units and test-verification instruments.

At the high end sits the K450 logic analyzer, which provides up to 10-ns resolution across 48 100-MHz channels or 5-ns resolution across 24 200-MHz channels. Memory depth is up to 4-K bits.

Unlike other analyzers that do housekeeping chores between levels and therefore miss critical data, the K450 does not miss data because it executes each level within a single clock cycle.

The instrument, which sells for between \$13,000 and \$20,000, has an auto-save feature that allows it to run unattended, storing time-and-date-stamped data on the unit's disk drive.

The K115, which is targeted at designing, debugging, and testing microprocessor applications, offers 32 or 64 state and timing channels in the same machine. Eight or 16 channels can be high-speed (5 ns/sample) channels. The analyzer, which has a maximum 200-MHz clock speed on up to eight channels, can be switched from state to timing modes by the push of a button.

Prices range from \$13,000 to \$18,000.

Also targeted at engineers working on microprocessor-based designs, but of a less complex nature, is the K40. The portable K40, which weighs 15 lb, fea-

operated as a peripheral to a CAE system, automatic-test-equipment setup, or IBM Corp. Personal Computer. By recording input signals from the system under test and uploading them to the host system as test vectors, design simulation can take place with actual operational input signals. The K125 then compares these results with the actual system to verify performance.

The K125, which sells for \$18,000 to \$24,000, is configurable with 8 to 80 channels per mainframe; multiple mainframes can be linked together, with cross-synchronization. Main channel cards provide 32 channels of 20-MHz clocking and high-speed cards provide eight channels of 100-MHz or four channels of 200-MHz clocking.

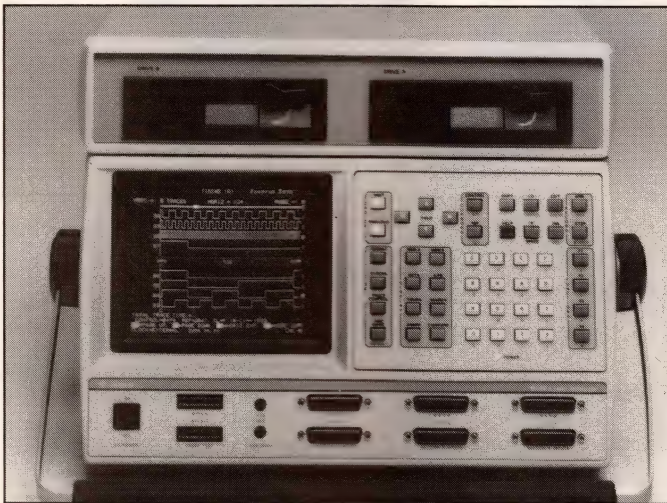
Gould claims it has a unique product in its PG110 pattern generator: it is the

only verification system designed especially for logic analyzers. The PG110, which sells for \$25,000, quickly confirms the performance of an engineer's logic analyzer.

All are available 30 to 45 days after receipt of order.

—Steve Zollo

Gould Inc., Design and Test Systems Division, 4650 Old Ironsides Dr., Santa Clara, Calif. 95054.
Phone (408) 988-6800 [Circle 404]



ON ITS OWN. Gould's top-of-the-line K450 analyzer can run unattended, capturing and storing data in its disk drives.

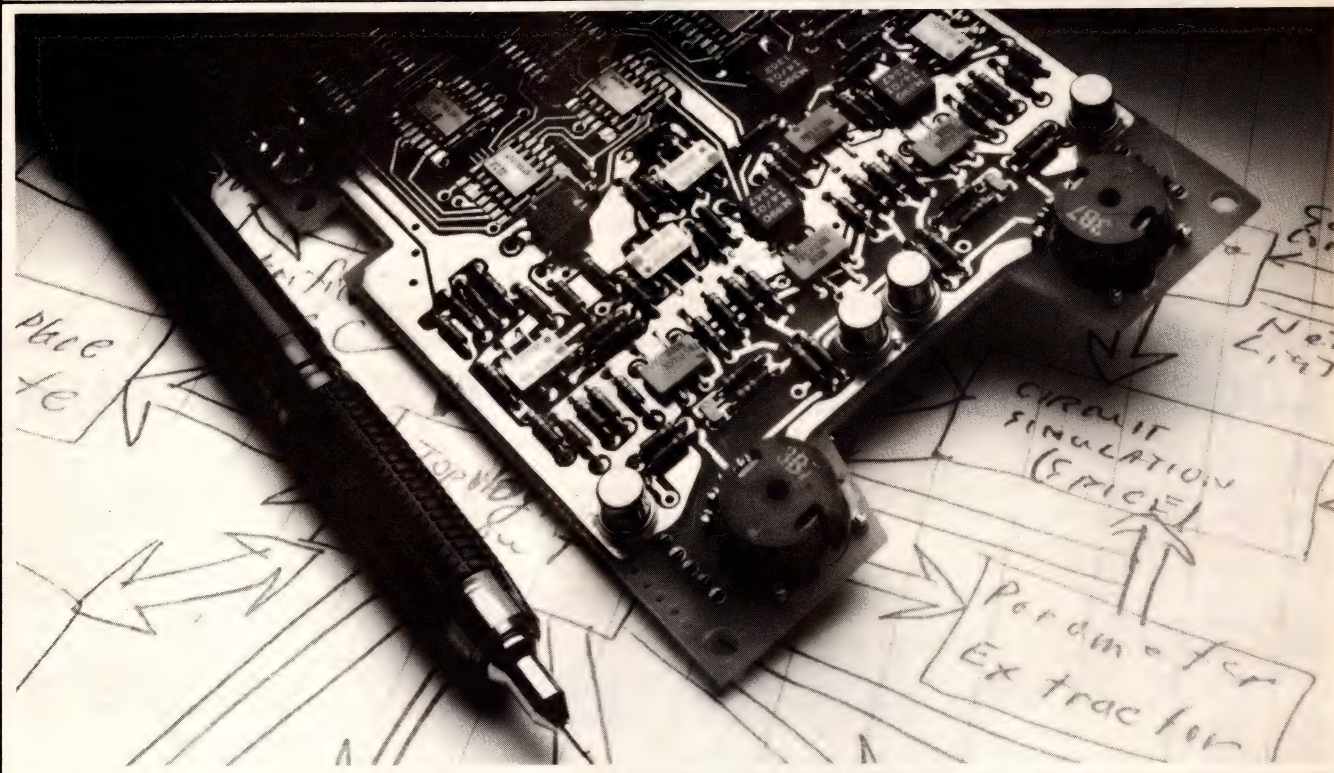
tures 32 15-MHz channels of state analysis or 16 state and 16 25-MHz timing channels. It can also be selected to handle four 100-MHz channels. It sells for between \$4,000 and \$5,000.

Gould's \$2,650 K20 is also a portable unit, weighing just 9 lb. It provides 24 state channels at 9 MHz or eight timing channels at 25 MHz, selectable to two 100-MHz channels.

The K125 digital engineering design- and test-verification instrument can be

Engineers and other high tech professionals

Are your plans bigger than your employers?



Engineers often work for big companies on big projects. Accordingly, they make big plans for their future. But if you've ever worked for a large company you know that you can plan on one thing for certain: that your best efforts—much like your aspirations—often go unrecognized.

A Big Difference

At Martin Marietta Denver Aerospace, you'll find that we have a different way of working together. Our matrix organizational structure gives you more opportunity to advance your career quickly. We planned it that way.

Here you'll find broader responsibilities. You'll work on more projects with a wider variety of people. As a result, the contributions you make receive wider recognition and your career moves ahead according to your plans.

Plan On This

Today, Martin Marietta is growing faster than ever. And while we already have some of the finest facilities in the world, at the foothills of the Rocky Mountains in Denver, Colorado, we're investing millions more to expand them.

Engineers will play a major role in accomplishing our goals in the near future. So, it could be that your plans and our plans look very much the same.

We have professional opportunities available for engineers and other high tech professionals with at least 3 years experience in:

- Systems • Electronics • Software • Test • Software Test
- Systems Safety • Logistics • Mechanical Engineering
- Software Quality Assurance • Contracts • Material Operations • Aerospace Program Planning
- Manufacturing • Finance Estimators

Other career opportunities exist at Martin Marietta in Baltimore, Maryland; Orlando, Florida; and New Orleans, Louisiana.

RECENT EXPERIENCE ON GOVERNMENT/DOD STATE OF THE ART PROGRAMS A REAL PLUS.

SPECIAL BACKGROUND INVESTIGATION MAY BE REQUIRED.

Please send your confidential resume to: Martin Marietta Denver Aerospace, P.O. Box 179, L1311, P1013, Denver, CO 80201. No agencies please, we prefer talking to the individual.

U.S. CITIZENSHIP REQUIRED

An Affirmative Action Employer Actively Seeking the Veteran and Handicapped.

MARTIN MARIETTA

ASYNCHRONOUS PATTERNS TEST CHIPS WITH TWO CLOCK RATES

LTX SYSTEM SIMULTANEOUSLY TESTS LINEAR AND DIGITAL ICs

The LTX90 integrated test system from LTX provides most everything a good follow-on product should: it does more for the same amount of money, uses 50% less power, and occupies only 60% of the space. Yet the successor to the LTX77 can test more complex devices. In a first for such gear, the tester uses asynchronous pattern generation.

The system, to be announced at the International Test Conference in Philadelphia this week, has two main components—the CP90 computer and TS90 test station. They work together to test both linear and digital large-scale ICs for semiconductor and telecommunications equipment manufacturers.

The system's integrated-signal-processing architecture provides enough speed to handle mixed-technology circuitry, which has become so integrated, says Brad Fisher, product information manager, "that it is nearly impossible to tell where the analog stops and digital begins." Chips often function at various send and receive rates, which can't be tested without an asynchronous capability. The asynchronous pattern generation allows users to test a chip with two or more clock rates at the same time.

The TS90 test station offers two independent channels each of waveform synthesis and analysis, a complete set of precision analog instruments, and 96 digital pins, or 48 I/O channels, with a maximum 5-MHz data rate that is expandable to 12.5 MHz and a maximum 20-MHz clock rate. Though the LTX77 and LTX90 each have 96 digital pins, the LTX90's smaller footprint and lower power consumption exact a penalty in the number of analog test pins. The LTX77 has 260 analog pins compared with 151 for the LTX90.

The waveform synthesizer boasts 16-bit resolution with a signal-to-noise ratio below 70 dB at maximum frequency and 86 dB below 10 kHz. The waveform digitizer's resolution is 15 bits with total harmonic distortion (up to 29 kHz) just 0.015% at the test socket. The S/N ratio is 80 dB typical at full scale.

The CP90's 16-bit double-precision computer has expansive memory to handle long test programs. Its distributed, high-speed array-processing and burst I/O technology—for high-speed data transfers—can process the large quantities of data used in integrated-signal-

processing testing. It's the burst I/O feature and the LTX90's 160-megabyte disk drive—compared with the LTX77's 80-megabyte drive—that give the ability to test more complex circuits than was possible with the earlier LTX77.

The computer runs LTX's full complement of soft instruments. These are software packages that perform such special testing tasks as fast Fourier transforms, matrix mathematics, convolution, correlation, and other sophisticated single-command signal-processing tools. The computer's vector-bus architecture supports two central processors and up to eight test stations. The computer has up to 512-K bytes of memory with an access time of 400 ns.

Fisher says the LTX90 can be programmed in an optimized Basic, but it can also use subprocedures, which put the test language on a par with Pascal and C. To test such analog characteristics as gain tracking, for example, an engineer must write some test code for

that function. This code remains independent but can be spliced into different test programs whenever the need for gain tracking arises.

The tester's operating system has a microcode for integrated-signal-processing algorithms and soft instruments for easy software adaptation as test needs become more complex. "This way, the person inventing the test program doesn't have to reinvent the wheel every time he needs to use an integrated-signal-processing function," Fisher says.

The LTX90 runs existing LTX software and is compatible with all LTX products. For ultrahigh integrated-signal-processing testing, the TS90 works with the new DTH100, a 100-MHz analog-to-digital test head.

The LTX90 sells for \$200,000 and is available immediately. —Debra Michals

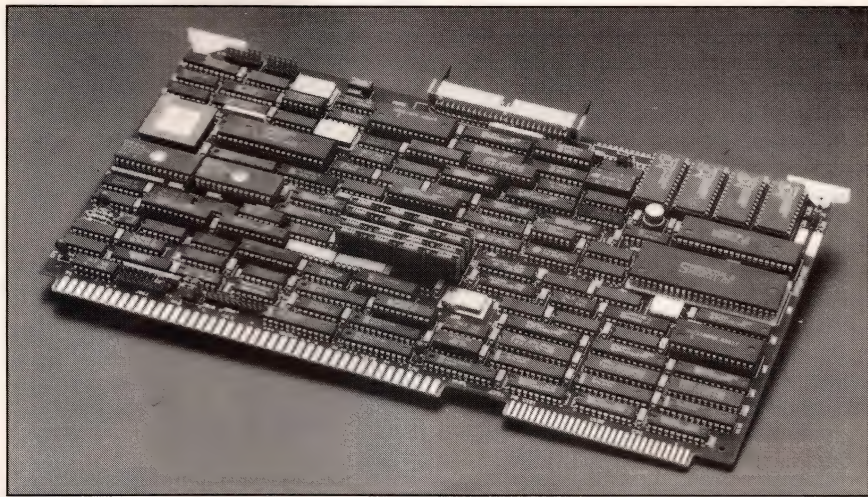
LTX Corp., LTX Park at University Ave., Westwood, Mass. 02090. Phone (617) 461-1000 [Circle reader service number 338]

MULTIBUS CONTROLLER HANDLES 16 CHANNELS

Two processors on a Multibus-based serial communications controller support a wide range of data-transmission protocols and up to 16 channels operating at 64 kb/s. The ProtoCol 1000 Multibus board is one of three communications controllers to be introduced by In-

terphase Corp. at Comdex/Fall '85 in Las Vegas this week.

The ProtoCol 1000 is built around two microprocessors. A Motorola 68010 16-bit microprocessor handles the communication protocols and buffer management. A Signetics Corp. 8X305 mi-



TEAM EFFORT. Interphase uses two processors on its Multibus communications controller.

crocontroller, operating at 5 million instructions per second, handles direct memory access as well as serial bit-stream control.

The two processors divide the tasks of serial control and data throughput as well as free the host processors of the data communications tasks. The dual-processor architecture makes possible the high throughput, says Tom Kent, marketing director. The board also uses up to 512-K bytes of triple-ported memory. The 68010 microprocessor, 8X305 microcontroller, and the system's Multibus all can access RAM.

CUSTOM PROTOCOLS. The general-purpose 68010 microprocessor enables system integrators to use their own custom protocols or standard communications software from Brice Systems Inc. The Great Falls, Va., company teamed up with Interphase to offer a protocol software library supporting X.25, Bisynchronous, 3270, 2780, and 3780 standards. IBM Corp.'s Systems Network Architecture communications will be supported in the future, says Kent.

The Multibus controller has up to 16 channels of full- or half-duplex communications. It will simultaneously handle any mix of protocols, in addition to a combination of RS-232-C, RS-449, and V.35 interfaces on a single board.

"We think we have taken communication controllers one step further with this board. It is pretty much a stand-alone system," Kent says. Brice Systems, for example, will make the controller the heart of its Multibus-based protocol-converter system and network gateways. In single quantities, the ProtoCol 1000 will sell for \$2,750. It will be available in volume by year end.

In addition, Interphase will introduce an eight-channel serial controller for VMEbus-based systems. The V/SIO 3208 is aimed at low-cost but high-performance serial communications with eight independent, full-duplex RS-232-C channels. Each of the eight channels has four software-programmable interrupts. The V/SIO 3208 will sell for \$795 when it becomes available at year end.

A Multibus-based wide-area network controller is also making its debut at Comdex. The WNC 5190 board was developed jointly with Apollo Computer Inc. of Chelmsford, Mass. The WNC 5190 provides a gateway in point-to-point links to a T1 carrier, microwave, satellites, and coaxial cable. The board can transfer up to 2 Mb/s over a full-duplex serial data path. It supports direct memory access with 24-bit addressing, and has 16-K bytes of buffer RAM for transmitting and receiving data.

The WBC 5190 is part of Apollo's Domain/Bridge hardware, which extends

the functionality of the network over long distances. The board may be integrated into a wide variety of networking systems, Kent suggests. The WBC 5190 sells for \$1,995 each and is available now.

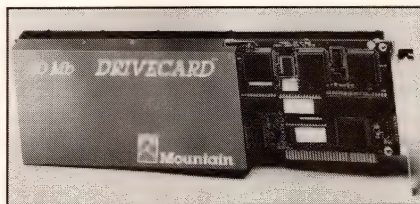
—J. Robert Lineback

Interphase Corp., 2925 Merrell Rd., Dallas, Texas 75229.

Phone (214) 350-9000 [Circle 339]

20-MEGABYTE DISK FITS INSIDE IBM PC

DriveCard is a complete internal 20-megabyte hard-disk drive mounted on a card. It integrates a 3½-in. Winchester disk drive with controller electronics and occupies 1½ card slots in the IBM Corp.



Personal Computer and its compatibles. The unit's half-slot portion fills the non-connector half of a full card-cage slot, leaving the connector open to accept another half-card-size peripheral.

Because it is internal, DriveCard doesn't require desktop space, cables, cooling fan, or a power supply. It is powered by 15 W from the computer's power supply. A user can install the unit, the maker says. DriveCard retails for \$1,195, including utilities software. A 10-megabyte version retails for \$995. Both units are shipping now.

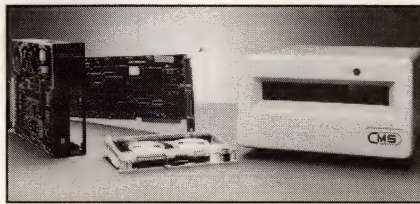
Mountain Computer Inc., 360 El Pueblo Rd., Scotts Valley, Calif. 95066.

Phone (800) 485-0300; in California, (800) 821-6066 [Circle 370]

60-MEGABYTE TAPE BACKS UP COMPAQ 286

Two ¼-in. tape-cartridge subsystems each deliver 60 megabytes of backup for Compaq Computer Corp. 286 personal computers. The T160-Ext, which is mounted in an external cabinet, serves the Deskpro 286 or the Portable 286. The T160-C, a half-height internal unit, serves the Deskpro 286.

Single-board controllers are included with both models, as well as a standard communications cable. The T160-Ext



sells for \$1,795 and the T160-C, \$1,495. Delivery is immediate.

CMS Inc., 401-B W. Dyer Rd., Santa Ana, Calif. 92707. Phone (714) 953-0470 or (714) 549-9111 [Circle 372]

PLOTTER WORKS FROM 1,024-COLOR PALETTE

The 5800 series of color plotters produces drawings up to 500 ft long with a nonimpact, electrostatic process. Resolution is 400 dots/in. The plotter has a permanent palette of 1,024 fill colors and 1,024 line types. Users can define nine more palettes with the plotter's proprietary software. With a 68-megabyte disk, it can store over 7 million color vectors.

Four separate toner stations are automatically monitored and replenished. The 5800 plotters perform integrated random vector-to-raster conversion and also color separation, freeing the host computer of this task. When the system's firmware needs upgrading, the user simply replaces the ROM cartridge.

The unit comes with RS-232-C and Centronics 8-bit parallel interfaces. The model 5825, which handles paper 24 in. wide, sells for \$68,000; the 5835 (36-in. paper), \$91,000; and the 5845 (44-in. paper), \$112,000. All will be available in the first quarter of 1986. For the IBM Corp. Personal Computer, the company has the ColorMaster thermal-transfer printer that will sell for \$4,495.

CalComp, 2411 W. La Palma Ave., Anaheim, Calif. 92801.

Phone (714) 821-2142 [Circle 382]

RF ANALYZERS COVER 1-MHz TO 2-GHz RANGE

Wiltron's radio-frequency analyzers make use of digital and thin-film technologies, which are usually reserved for higher-priced microwave instrumentation. The model 6407 covers the range from 1 MHz to 1 GHz, the 6409 from 10 MHz to 2 GHz.

Designed to replace the company's model 640, the new line simplifies measurement of transmission, return loss, and absolute power in the design of satellites, amplifiers, filters, and antennas.

Thanks to microprocessor control, the instruments boast a frequency accuracy to within 100 kHz and have virtually no frequency drift during narrow sweeps. Nine front-panel setups allow production personnel to switch freely among a series of standard test conditions.

The 6407 sells for \$9,430 and the 6409 for \$11,040; both analyzers will be available next month.

Wiltron, 490 Jarvis Dr., Morgan Hill, Calif. 95037. Phone (408) 379-6578 [Circle 365]

Advertisers Index

AEG Corporation	2	Mitel Corporation	63
Advanced Micro Devices	14, 15	Motorola Corporate	48, 49
AMP Incorporated	78, 79	Multiwire	4
Ando Electric Co. Ltd.	80, 81	Murata Manufacturing Co.	8
Anritsu Corporation	32, 33	National Semiconductor	6-7
AT&T Inc.	35, 38	Ontario Centre for Microelectronics	71
‡ Barbados Industrial	88	Robinson Nugent	45
Brown Manufacturing	67	* Rohde & Schwarz	8E
* Chicago Laser Systems	91	* SGS Micro Electronics	1E-3E
Coreco	76	* Siemens AG Munchen	13, 46, 47
* CSEM	60	■ Signal Transformer	4th C
DATA Images	74	‡ TDX Corporation	13
Data Translation	20	‡ Teac	60
Dy 4 Systems	65	* Teknecomp	4E
GenRad	18	Teledyne Crystallonics	9
* Gould Incorporated	5E	‡ Ten-Tec Incorporated	88
Harris Semiconductor	16	‡ Teradyne Incorporated	46, 47
‡ Holt, Inc.	8	Texas Instruments Incorporated	28-29
Interactive	73	* Thomson Cepe	7E
■ Kepco Incorporated	53, 56	‡ Toshiba America, Inc.	90-91
Kyowa Electronic	1	Valid Logic	10-11
Livingston Development	77		
LSI Logic	2nd C		
Matrox Electronic Systems	69		
McDonnell Douglas Corp.	22		

Classified and employment advertising

Hayes Micro Computer	3rd C
J. Jaussaud	94
Martin Marietta	104
ZTEC	94

- For more information of complete product line see advertisement in the latest Electronics Buyers Guide
- * Advertisers in Electronics International
- ‡ Advertisers in Electronics domestic edition

Advertising Sales Staff

Atlanta, Ga. 30319: Joseph Milroy
4170 Ashford-Dunwoody Road N.E.
[404] 252-0626

Boston, Mass. 02116:
M. E. "Casey" McKibben, Jr.
575 Boylston St.
[617] 262-1160
633-0155 Mobil Phone

Chicago, Ill. 60611: William J. Walker
[312] 751-3738
645 North Michigan Avenue

Cleveland, Ohio 44113:
[215] 496-3800

Costa Mesa, Calif. 92626: Fran Cowen
3001 Red Hill Ave. Bldg. #1 Suite 222
[714] 557-6292

Dallas, Texas 75240: Harry B. Doyle, Jr.
5151 Belt Line Road, Suite 907
[214] 458-2400

Englewood, Co. 80112: Harry B. Doyle, Jr.
7400 South Alton Court Suite 111
[303] 740-4633

Houston, Texas 77040: Harry B. Doyle, Jr.
7600 West Tidwell, Suite 500
[713] 462-0757

Los Angeles, Calif. 90010: Chuck Crowe
3333 Wilshire Blvd.
[213] 480-5210

New York, N.Y. 10020:
Matthew T. Reseska [212] 512-3617
John Gallie [212] 512-4420
1221 Avenue of the Americas

Stamford, Ct. 06902:
Albert J. Liedel
777 Long Ridge Road. Bldg. A
[203] 968-7115

Palo Alto, Calif. 94303:
Larry Goldstein, Jeffrey C. Hoopes,
Lauren Scott
1000 Elwell Court, [415] 968-0280

Philadelphia, Pa. 19102: Joseph Milroy
Three Parkway, [215] 496-3800

Pittsburgh, Pa. 15222: Matthew T. Reseska
Suite 215, 6 Gateway Center, [215] 496-3800

Southfield, Michigan 48075:
4000 Town Center, Suite 770, Tower 2
[313] 352-9760

San Francisco, Calif. 94111:
Larry Goldstein, Jeffrey C. Hoopes,
Lauren Scott
425 Battery Street
[415] 362-4600

Brussels: Art Scheffer
23 Chaussee de Wavre
Brussels 1040, Belgium
Tel: 513-73-95

Frankfurt/Main: Fritz Krusebecker, Dieter Rothenbach
19 Liebigstrasse, Germany
Tel: 72-01-81

Milan: Savio Pesavento
1 via Baracchini, Italy
Tel: 86-90-656

Paris: Jean - Christian Acis
17 Rue-Georges Bizet, 75116 Paris, France
Tel: (1) 47-20-33-42

Scandinavia: Andrew Karnig
Finnbodavagen
S-131 31 Nacka
Sweden
Tel. 46-8-440005
Telex: 17951 AKA S

Tokyo: Hirokazu Morita
McGraw-Hill Publications Overseas Corporation,
Kasumigaseki Building 2-5, 3-chome,
Kasumigaseki, Chiyoda-Ku, Tokyo, Japan
[581] 9611

United Kingdom: Art Scheffer
34 Dover Street, London W1
Tel: 01-493-1451

Business Department

Thomas E. Vachon
Director of Operations
[212] 512-2627

Leon Irgang
Circulation Director
[609] 426-5542

Frances M. Vallone
Reader Service Manager
[212] 512-6058

Thomas M. Egan
Production Director
[212] 512-3140

Carol Gallagher
Production Manager
[212] 512-2045

Evelyn Dillon
Production Manager Related Products
[212] 512-2044

Classified and Employment Advertising

[212] 512-2556

ELECTRONICS WEEK®

GaAs IC PRICES COME DOWN

The company that introduced the first gallium arsenide digital integrated circuits available commercially, Harris-Microwave Semiconductor, Milpitas, Calif., a division of Harris Corp., of Melbourne, Fla., is lowering the chips' prices. The cuts indicate that "GaAs digital ICs are moving along more or less the same learning curve as silicon," says a company spokesman. Prices on some of Harris's small- and medium-scale ICs are dropping by 25% to 40%.

COMMODORE POSTS LOSS IN QUARTER

Introducing new computers to the public can be an expensive proposition, as Commodore International Ltd. has found out. The company reported last week that it lost \$39.2 million on sales of \$159.2 million in the first quarter of its fiscal year. A year ago, Commodore earned \$27.7 million on sales of \$244.23 million. Commodore chairman Irving Gould said the company's performance was hurt by the introduction of the new Amiga and Commodore 128 computers.

ISAACSON STARTS SOFTWARE FIRM

A cofounder of market research company Future Computing Inc., Dallas, has formed a new company to develop home-automation software. Portia Isaacson has started Intellisys Corp., also in Dallas. Intellisys is working on software that will work on most cabling schemes and expects revenue in 1987 from license agreements, although it may be several years before products get to end users.

JAPANESE ADD TO U. S. TELECOM WORK

Japanese telecommunications-equipment makers, try-

ing to blunt the effects of U. S. protectionist pressures, are increasing their U. S.-based production this year by more than 70%—to about \$434 million. The effect has been to lower the rate of Japanese exports to the U. S. market 17.5% in August, the most recent month for which figures are available. Overall, Japanese telecommunications exports to the U. S. are up by 4.8% for the first eight months of 1985, compared with a 92% gain for the same period last year, when Japan exported a total of \$2.45 billion worth of telecommunications equipment to the U. S.

DEC TO INTRODUCE IBM PC-COMPATIBLE

Digital Equipment Corp., Maynard, Mass., reacting to pressure from customers for an IBM Corp. Personal Computer-compatible, will soon field its own machine, according to Kenneth H. Olsen, the company president. Though he declines to say exactly when the computer will be available, Olsen says DEC's MS-DOS system will have more functionality and will consequently be more expensive than the IBM machines. The computer will not be sold in retail outlets.

BACHMAN WINS IEEE PRESIDENCY

Henry Bachman is the new president-elect of the Institute of Electrical and Electronics Engineers. The vice president of engineering at Hazeltine Corp. of Commack, N. Y., Bachman won the annual race with a 55% share of the 42,607 votes cast. He defeated José B. Cruz Jr., who is a professor in the University of Illinois' Department of Electrical and Computer Engineering. Cruz ran his second losing campaign in a row for the post, which carries a three-year commitment to the organization. Bachman will serve one year each as president-elect, president, and

past president, each of which is a voting position on the IEEE board of directors.

COMPAQ PORTABLE IS SPY-PROOFED

Houston's Compaq Computer Corp. is looking for government sales with a new portable personal computer. The 3100T is designed to prevent possible security leaks by suppressing the electromagnetic radiation that computers produce. The 16-bit machine incorporates high-security electronics from the Loral Electro-Optical Systems subsidiary of New York's Loral Corp.

THOMSON OKS DEAL FOR MOSTEK

After weeks of transatlantic negotiations, Thomson-CSF has agreed to buy Mostek Corp. from United Technologies Corp. for \$71 million. The French company acquires most of Mostek's assets, chip inventories, product lines, technologies, and associated rights [*Electronics*, Nov. 11, 1985, p. 72]. Not included in the deal is Mostek's wafer-fabrication plant in Ireland, which is still for sale. Thomson plans to keep a Mostek work force of about 1,000 in Carrollton, Texas. Mostek president James R. Fiebigler will stay on with Thomson.

SPRAGUE ENTERS PLD MARKET

Sprague Solid State, the Willow Grove, Pa., division of Sprague Electric Co., has joined the crowded but lucrative market for programmable logic devices with a family of high-speed circuits to compete with bipolar devices. The parts boast a 25-ns clock speed and a 15-mA quiescent power consumption. Market researcher Dataquest Inc., San Jose, Calif., estimates sales at \$27 million this year compared with \$295 million for bipolar versions, but says

that by 1989 the market should even out at \$420 million for programmable logic and \$489 million for bipolar.

DOD TO PUSH GaAs DEVELOPMENT

The development of microwave and millimeter-wave monolithic technology based on gallium arsenide got a big boost this month when the Pentagon revealed it will seek \$135 million for a five-year program to cut production costs for single-substrate GaAs circuits. The new project, dubbed Mimic, is patterned after the Pentagon's Very High-Speed Integrated Circuits program. Phased-array and space-based radar, satellite communications, and electronic-warfare systems are expected to be the primary applications.

TANDY COMPATIBLE UNDERCUTS PC AT

Tandy Corp. will soon introduce a model 3000, which is compatible with IBM Corp.'s Personal Computer AT and costs about \$1,000 less. The basic 3000 will cost \$2,599. Some analysts say the low price on the 3000 may touch off price cutting in the high-end personal computer markets. The Fort Worth, Texas, computer retailer also plans to spend \$80 million over the next five years to refurbish stores in its Radio Shack chain.

XILINK, SEIKO PLAN LOGIC-CELL EFFORT

Xilinx Inc. of San Jose, Calif., and Seiko Epson Corp. of Japan have agreed to design, manufacture, and market logic-cell arrays and development systems. Seiko Epson will provide Xilinx with CMOS manufacturing capabilities until demand warrants construction of a Xilinx plant. The companies will also jointly develop a modification of the Seiko Epson CMOS process.



Telecommunications Engineers

HAYES... Leading A Telecommunications Revolution From Atlanta and San Francisco.

We've built a powerful engineering and technical team here at Hayes. It's been our strength and the reason for our success from the very beginning. Our focus has been on recruiting and developing the talent it takes to do more than merely compete, but to lead. The result has been a success story few in the industry can equal.

For those of you who have searched far and wide for just such an environment, where talent is provided the freedom and encouragement to grow, then perhaps it's time to take a good, hard look at Hayes, with opportunities in both San Francisco and Atlanta. There's a future in it.

- VLSI/DSP DEVELOPMENT ENGINEERS
- HARDWARE/SOFTWARE DESIGN ENGINEERS
- SOFTWARE PROGRAMMERS & ANALYSTS
- MANUFACTURING/TEST ENGINEERS
- PRODUCT DEVELOPMENT ENGINEERS
- QUALITY/RELIABILITY ENGINEERS

Interested, qualified candidates should forward a confidential resume to: **Hayes Microcomputer Products, Inc., Dept. 85-306, P.O. Box 105203, Atlanta, GA 30348.** An Equal Opportunity Employer, M/F.

Hayes®
Say yes to the
future with Hayes.

Once again, Signal succeeds in establishing another breakthrough for specifiers... a standard transformer line designed to meet all critical international specifications, i.e. VDE, IEC, CSA, etc., as well as the new emerging generation of UL standards. And, as always, we're stocked in depth for immediate PRONTO delivery. A new dual, high-temperature bobbin with an insulating shroud is featured on all models. An immediate benefit is better performance and lower costs than conventional split-bobbin design units.

ONE-4-ALL™ SERIES (PC AND CHASSIS MOUNTS)

Available in 2.5 to 175 VA, ONE-4-ALLs are packed with highly stable, high-temperature material that exceeds UL flammability requirements. And they're ready to go with an overall insulating shroud that provides 4000V RMS test voltage and superior isolation.

So, while ONE-4-ALL transformers offer world class performance, re-engineering reduces costs... resulting in lower prices than those of existing split-bobbin types.

signal goes international

MORE-4-LESS™ SERIES

With this new design, your system can really take off. With lighter transformers and 1/3 less space. All at a lower ticket price than most competitors. Plus dual screw or quick-connect terminals. 300 to 1000 VA. And high isolation (4000V RMS test).

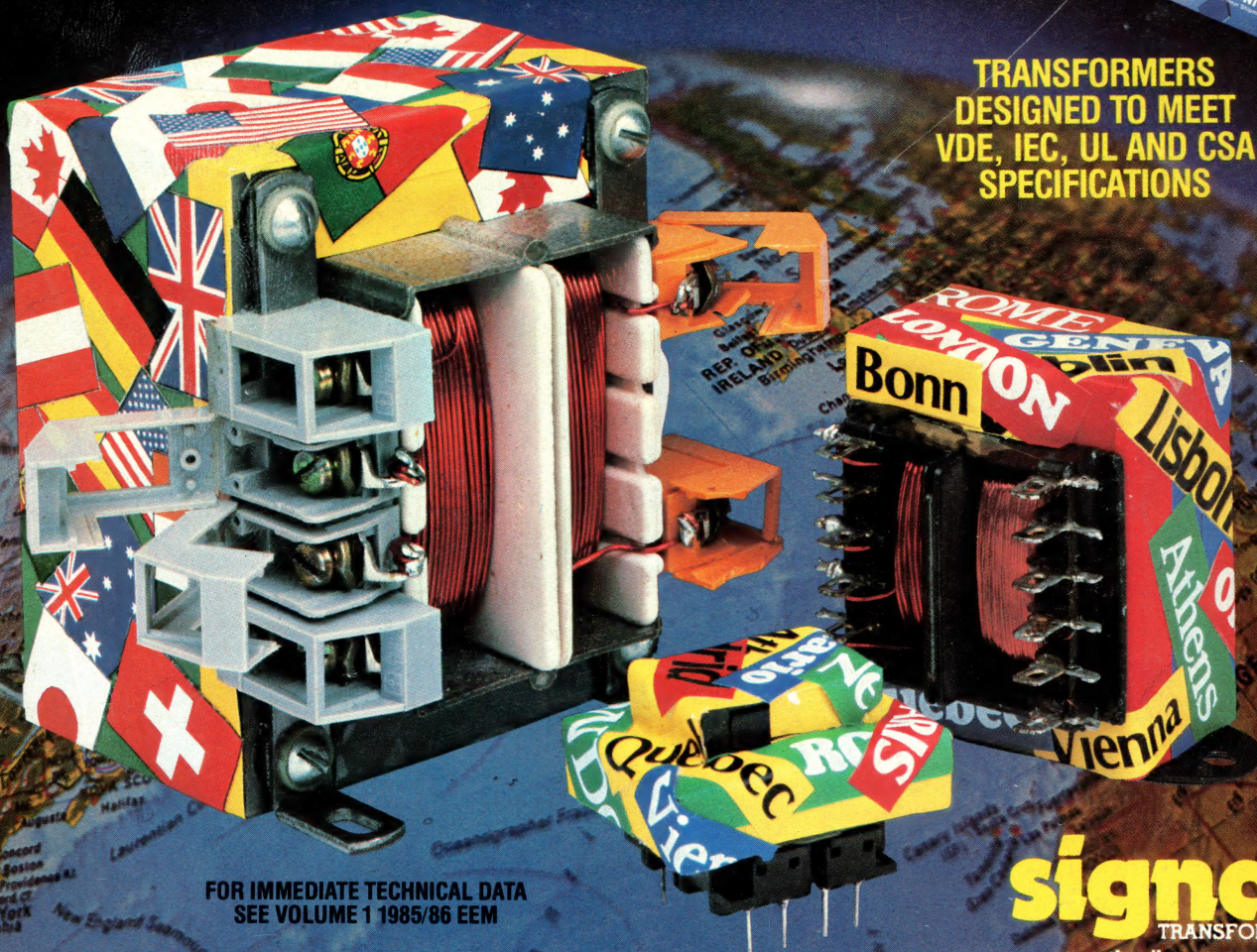
PRONTO 48-HOUR SHIPMENT GUARANTEED

Our PRONTO service promises to ship your orders (moderate quantities) within 48 hours. Usually we can fill the entire order.

So if you're ready to go out in the world, get on board with Signal's international series of transformers. For a copy of our latest transformer catalog, contact: Signal Transformer, 500 Bayview Ave., Inwood, NY 11696. Phone: (516) 239-5777.



**TRANSFORMERS
DESIGNED TO MEET
VDE, IEC, UL AND CSA
SPECIFICATIONS**



FOR IMMEDIATE TECHNICAL DATA
SEE VOLUME 1 1985/86 EEM

signal
TRANSFORMER
An Insilco Company

Circle 902 on reader service card